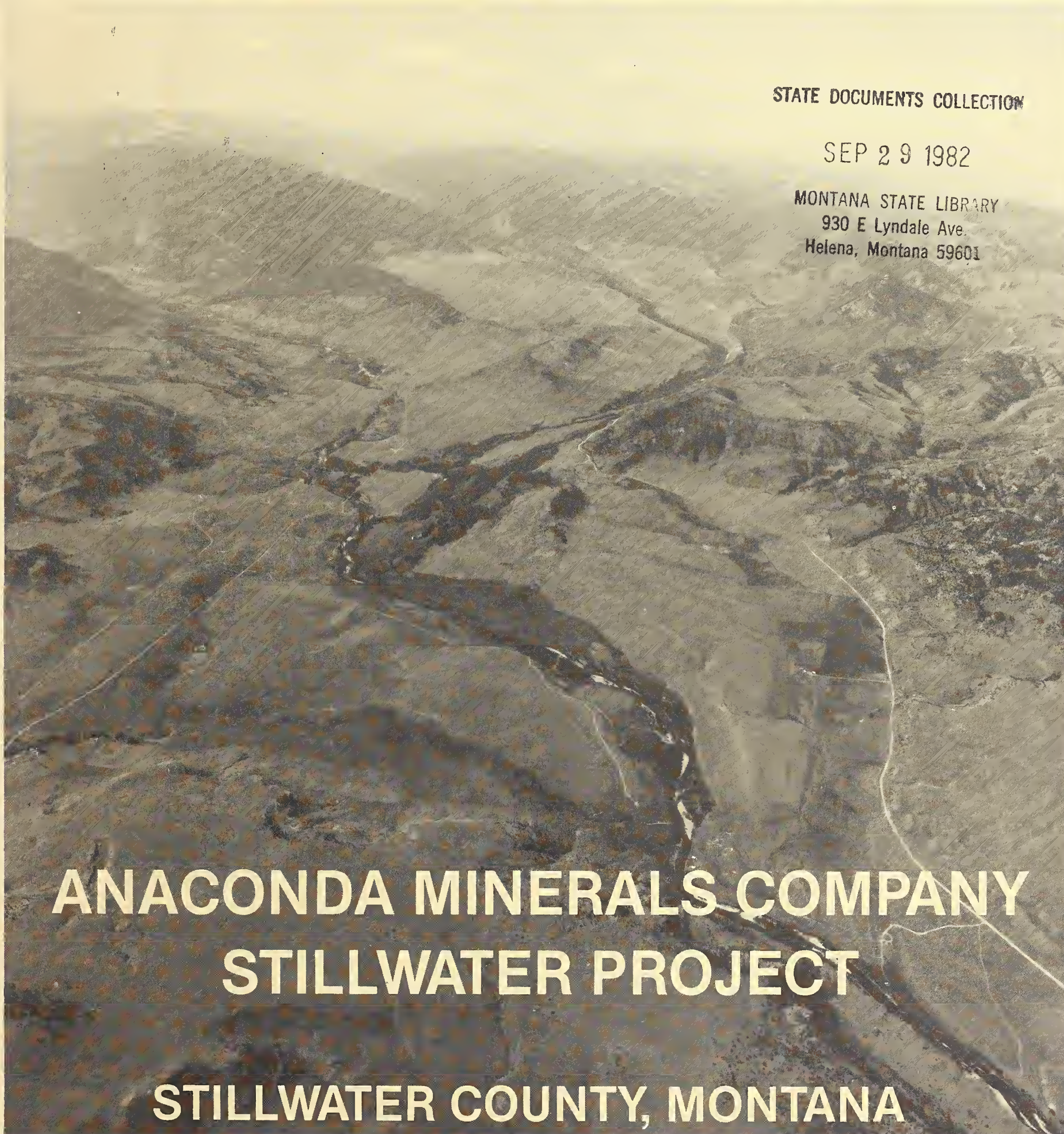
DRAFT

ENVIRONMENTAL IMPACT STATEMENT



ANACONDA MINERALS COMPANY STILLWATER PROJECT

STILLWATER COUNTY, MONTANA

Montana Department of State Lands and U.S. Forest Service

DEPARTMENT OF STATE LANDS

TED SCHWINDEN, GOVERNOR

CAPITOL STATION

STATE OF MONTANA

(406) 449-2074
(406) 449-4560 RECLAMATION DIVISION

1625 ELEVENTH AVENUE
HELENA, MONTANA 59620

June 14, 1982

Dear Reader:

Enclosed for your review is a draft environmental impact statement (EIS) for Anaconda Minerals Company's proposed platinum-palladium mine and mill near Nye, Montana. The Montana Department of State Lands and the U.S. Forest Service, the preparers of this document, would like your comments on its content.

Before Anaconda Minerals Company can commercially develop its mineral claims, it must receive an operating permit from the Montana Department of State Lands, approval of its plan of operations from the U.S. Forest Service, and air and water quality permits from the Montana Department of Health and Environmental Sciences. This document, prepared to meet Montana Environmental Policy Act (MEPA) and National Environmental Policy Act (NEPA) requirements, is a tool to ensure the project is well planned.

If public comments or new information requires major changes in the analysis, a final EIS will be issued before a decision is made on the proposed mining and reclamation plan. The final EIS may incorporate portions of the draft EIS by reference; therefore, please retain this copy for later use.

All comments must be received by August 23, 1982, to be considered by the Department and the U.S. Forest Service in the final EIS. Please send all comments to Mr. Kit Walther, EIS Team Leader, Montana Department of State Lands, 1539 11th Avenue, Helena, Montana 59620.

A public hearing has been scheduled for July 8, 1982, at 7:00 p.m. at the Absarokee High School, Absarokee, Montana. Staff from the Department of State Lands and the U.S. Forest Service will be present to receive public comment on the draft EIS.

Additional information on Anaconda's mine plan is available from the Department's Helena office or from the U.S. Forest Service, Custer National Forest, 2602 1st Avenue North, Billings, MT 59103.

Brace Hayden

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Administrator
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David A. Filius

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Custer National Forest
U.S. Forest Service

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MONTANA DEPARTMENT OF STATE LANDS
and
U.S. FOREST SERVICE

JUNE 1982

JAMES F. MANN, FOREST SUPERVISOR
Custer National Forest

GARETH MOON, COMMISSIONER
Department of State Lands

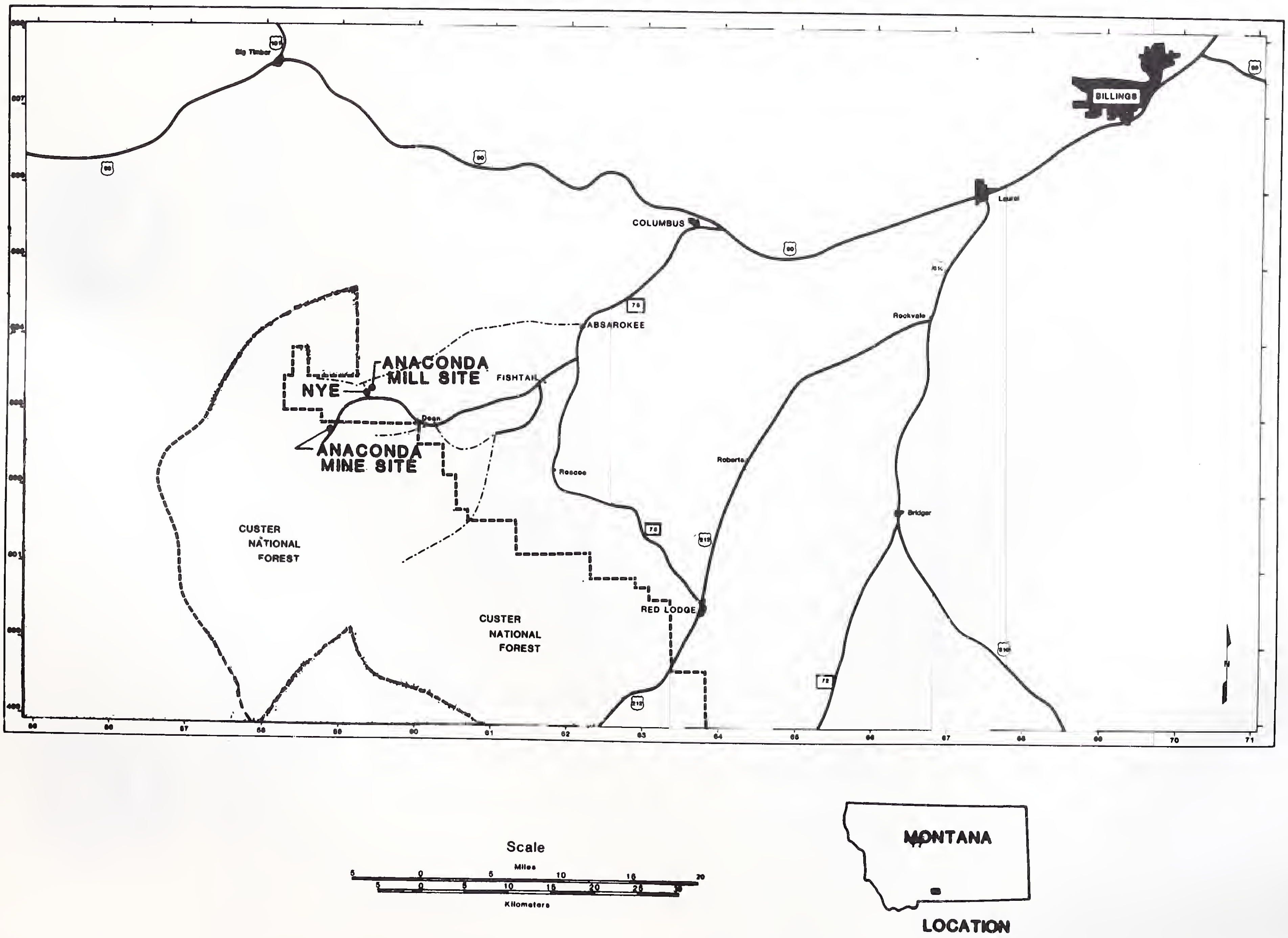

FIGURE S-1--Location of the Project Area

SUMMARY

Action Under Consideration

The Anaconda Minerals Company proposes to open a platinum and palladium mine and mill in the Stillwater Valley of Stillwater County, Montana. (See fig. S-1.) Most of the project lies on private land. A small part lies on national forest system lands. The Commissioner of State Lands must decide whether to approve the permit as applied for by Anaconda, deny the permit, or approve the permit subject to stipulations. The Supervisor of the Custer National Forest must decide whether to approve the plan of operations as submitted, approve a revised plan of operations with changes incorporated, or disapprove the plan of operations.

The Forest Service's preferred administrative alternative is to approve a revised plan of operations with changes incorporated. Those changes that would be required are discussed in chapter IV. In keeping with a different administrative process, the Department of State Lands does not identify a preferred alternative at this time.

Substantive comments made by the public on this document will be considered and responded to in the final EIS. The Forest Service will make a final decision on Anaconda's plan of operations at the time of the publication of the final EIS. The Department of State Lands can make a decision no sooner than 15 days following publication of the final EIS.

Brief Description of the Company's Proposal

Anaconda Minerals Company proposes to mine platinum and palladium from a steeply dipping mineralized zone lying within the Stillwater mineral complex. Anaconda has begun exploration activities, and if its permit were approved, the company could begin full mine development in late 1982. The project would last 20 years. The company would mine an average 1,000 tons of ore per day by shrinkage stoping, an underground mining method. Ore would be trucked 7 miles on county roads FAS 419 and 420 to a concentrating mill that would be located in Hertzler Valley. Tailing from the milling process would be deposited adjacent to the mill in a tailing pond. The project permit area covers 780 acres, including 90 for the mine and 690 for the mill and tailing pond. Concentrate from the mill would be trucked to Columbus and shipped by rail to various markets.

Alternatives Considered

A number of alternatives to the proposed action were considered, including (1) moving the adit entrances, (2) moving the surface facilities, (3) moving the mill and tailing pond sites, (4) using cut-and-fill stoping rather than shrinkage stoping, (5) using sublevel long-hole stoping rather than shrinkage stoping, (6) constructing a slurry line to transport tailing to the tailing pond rather than using trucks to transport the ore to the mill, (7) constructing a conveyor rather than using trucks, (8) constructing a private haul road rather

than routing haul trucks along county roads, (9) using milling processes other than the flotation method proposed, and (10) satisfying the United States' need for platinum and palladium by means other than developing the proposed project. The alternative of not having the project (termed "no action" by the Forest Service) was also considered.

Summary of Impacts

Geology. Changes in the geologic environment from Anaconda's project would not be significant. The changes that would occur include (1) removal of the ore body, (2) construction of a waste dump at the minesite, and (3) filling of a small tributary valley of the Hertzler Valley with tailing. A landslide of the material near the minesite or failure of the crown pillar above Anaconda's underground excavations, although considered of low probability, would significantly affect the area.

Hydrology. The project would not significantly affect either present or future uses of ground or surface waters in the Stillwater Valley. Neither the mining nor the milling and tailing operations would noticeably change the water quality of the Stillwater River or the quantity or quality of the ground water systems of the Hertzler Valley. To date, discharge from Anaconda's exploration adit has produced water of good quality--low in acidity and metals, generally comparable to natural ground water discharge in the area.

Soils. The project's impacts on soils would not be significant, providing mitigating measures at least as effective as those discussed at the end of chapter IV, Vegetation, are implemented. However, due to the removal and storage of soils, unavoidable impacts, such as a loss of soil structure and a reduction in organic matter content, would occur.

Vegetation. Anaconda's revegetation plan would be moderately successful overall; however, low water- and nutrient-holding capacity of the soil and waste material, as well as moderate to locally severe wind and water erosion, could hinder revegetation in some areas. The proposed revegetation plan, which aims at enhancing wildlife habitat, could be improved by including trees, shrubs, and forbs with the other species proposed for revegetation.

Aquatic Ecology. The aquatic system would not be significantly affected by Anaconda's proposal. Game-fish populations could be reduced from possible overfishing associated with increased recreational use of the Stillwater River and its tributaries.

Wildlife. Increased disturbances by mining and milling could lead to the reduction of the bighorn sheep herd. Stewart (Montana Department of Fish, Wildlife, and Parks, personal commun., May 18, 1982) believes there exists a small potential for herd elimination. Increased traffic in the valley would lead to a greater number of road-killed mule and white-tailed deer. The mine and mill operations may displace deer

from traditional winter ranges, although displacement is anticipated to be temporary.

Threatened and Endangered Species. The U.S. Fish and Wildlife Service has identified historical nesting habitat for peregrine falcons on a cliff complex near the proposed haul route. Ore hauling may discourage this endangered species from selecting nesting sites on the cliff complex or prompt nest abandonment if the nest is active (U.S. Forest Service Biological Assessment, February 23, 1982). In addition, carcasses of road-killed wildlife left on the roads in the area may attract bald eagles, which in turn could be struck and killed by vehicles.

Climate. The climate would not be affected by the project.

Air Quality. Particulate matter, the only pollutant emitted in significant quantities by the project, would be minor; modeling indicates that total suspended particulate concentrations would increase by a maximum of 7 ug/m^3 (micrograms per cubic meter) at the mine and 5 ug/m^3 at the mill. Ore dust blown from haul trucks moving from the mine to the mill on county roads FAS 419 and 420 could be a nuisance to residents along these roads.

Employment and Income. The operation of the mine and mill would create a total of about 263 new jobs in Stillwater County. The new jobs would represent two thirds of the total employment growth projected for the county during the 1980s. An additional 50 short-term jobs would be created between 1989 and 1992, when a second internal support shaft would be developed. Growth in mining employment would offset the projected job losses in agriculture, but agriculture would continue as the county's largest basic industry employer.

Sociology. The greatest change would be in the population structure of Absarokee and Nye. The occupational structure of Absarokee would shift to a large proportion of jobs in mining. Some current residents of the Absarokee community would have less influence over community matters. By 1991 Stillwater County's population would increase 12 percent, and the community of Absarokee's by 54 percent, over the levels that would be reached without the project.

Community Services. The project would result in additional demand for staffing, space, and equipment or operating revenue by the following: Absarokee school system, the city of Columbus, the Stillwater County law enforcement system, the Absarokee Water Users Association, sewer district numbers five and seven, and possibly the Stillwater County Welfare Department. Additional housing in the county would also be needed as a result of the project.

Fiscal Conditions. Locally, the project would directly increase the tax base of the Nye elementary school district, Absarokee high school district, and Stillwater County by about $6,853,000. Over the life of the mine the State would receive about $11 million in revenue

raised through the Metalliferous Mines License Tax and the Resource Indemnity Trust Tax.

Land Use. The project would not significantly affect land use patterns in the area. A total of 165.8 acres would be disturbed by the project and as many as 33 additional acres would be permanently converted to residential uses as a result of population increases caused by the project. Despite some difficulties with revegetation, the postreclamation range condition would be better than it is now.

Transportation. Increases in work, household, and truck trips related to the project would significantly increase traffic volumes on FAS 419 and FAP 78. Increased traffic would result in increased vehicle accidents and road maintenance costs. Ranchers, recreation travelers, and wildlife could also be adversely affected.

Recreation. The project would bring increased use to both the national forest and the private lands adjacent to the Stillwater River. This would increase person-to-person contacts; put additional public pressure on the Forest Service to develop new public access routes to the national forest; increase harvest of fuelwood; and cause weekend crowding on roads and campgrounds. Visual changes and noise from the mill would affect the recreational quality of the Moraine Fishing Access site.

Cultural Resources. Two cultural resource sites are located within the permit area and could be damaged by vandalism or mine-related disturbances. Five additional sites outside the permit area may be adversely affected by road work. Six other sites outside the permit area may be damaged by increased vandalism. All 13 of these sites are potentially eligible for listing on the National Register of Historic Places.

Aesthetics. The project would significantly affect visual resources at the mine and mill sites. Some recreation travelers and local residents would find the views highly objectionable. Others may consider the project's activities highly educational and interesting. Noise levels near the mine, mill, and the highway connecting the two (parts of FAS 419 and FAS 420) would increase. The resulting noise levels may be annoying to nearby residents.

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INTRODUCTION

The Anaconda Minerals Company (formerly the Anaconda Copper Company) is proposing to construct and operate a platinum-palladium mine and mill in the Stillwater River Valley of Stillwater County, Montana. Three percent of the proposed project lies on Federal land--Custer National Forest. The remainder of the project lies on private land. Before beginning operations the company must (1) obtain an operating permit from the Montana Department of State Lands (DSL) and (2) receive approval of its plan of operations from the U.S. Forest Service.

The Forest Service and DSL have determined that the mine may significantly affect the quality of the human environment. In accordance with both the National Environmental Policy Act and the Montana Environmental Policy Act, an environmental impact statement (EIS) must therefore be written before any action on the project can be taken. The EIS is one of the tools that ensures that the proposed operation is well planned, environmentally sound, and that the concerns of all are heard and considered before the necessary decisions are made.

A. AGENCY RESPONSIBILITIES

1. Montana Department of State Lands (DSL)

DSL administers the 1971 Montana Metal Mine Reclamation Act (formerly the Hard Rock Mining Act) to which the Anaconda Minerals Company must conform. The reasons for the act are, first, to recognize and protect the usefulness, productivity and scenic values of the lands and waters within the State, and second, to reclaim to beneficial use the lands used for metal mines. The act and subsequent regulations (ARM 26.4.101 et seq.) set forth the steps that must be taken in the issuance of an operating permit for, and the reclamation of, Anaconda's proposed mine and mill. The act applies to all lands within the State. For the Anaconda Stillwater Project, DSL will regulate mining activity on both Federal and private lands.

2. U.S. Forest Service

The Forest Service's authority for permitting operations is primarily limited to facilities and uses of national forest system lands. Figure I-5 shows the extent of private versus public ownership at the minesite. The mill site lies entirely on private land.

The 1872 Mining Law, as amended by the Multiple Surface Use Act (PL 167) of July 23, 1955, allows any prospector who discovers a valuable mineral deposit on national forest system lands open to mineral entry to locate and work a mining claim. At the same time, the Organic Administration Act of 1897 authorizes the Secretary of Agriculture to regulate occupancy and use of the national forests for the protection and management of national forest resources--this pertains to all national forest users, including prospectors and miners. The Forest Service thus retains the right to manage and dispose of surface resources on

unpatented mining claims to the extent that this does not unreasonably interfere with mining activity.

(The reader should note that mining claims are either patented or unpatented. Patented claims are private property and are thus not regulated by the Forest Service. The surface of unpatented claims are owned and managed by the Federal government. Mining activity on unpatented claims (as well as activity on unclaimed lands) on national forest system lands is subject to Federal regulations. The claimant may patent a claim by demonstrating that a discovery of a valuable mineral deposit exists and by complying with other legal requirements. Once a claim is patented, regulatory authority falls solely to DSL. Anaconda's development would occur on both patented and unpatented claims.)

The U.S. Forest Service regulates mining activity under a number of other laws, including the Mining and Mineral Policy Act of 1970, the National Materials and Minerals Policy, Research, and Development Act of 1980, and a number of Executive (Presidential) Orders.

The Forest Service is also responsible as the lead Federal agency to complete a biological assessment to determine if the proposed project "may affect" threatened and endangered species or their habitats.

3. U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service is responsible for enforcement and administration of most Federal legislation involving wildlife, including the Endangered Species Act and the Bald Eagle Protection Act. Because of the involvement of threatened or endangered species with the proposed project and the involvement of bald and golden eagles in the project area, the Fish and Wildlife Service will be a consulting agency in this project. The Service will render a biological opinion on whether or not the project will jeopardize the continued existence of a threatened or endangered species and what coordinating measures would be required to avoid adverse effects.

4. State Historic Preservation Office

The State Historic Preservation Office is responsible for reviewing this EIS to ensure compliance with cultural resource regulations.

5. Montana Department of Health and Environmental Sciences

a. Air Quality Bureau

Anaconda Minerals Company must apply for an air quality permit from the Air Quality Bureau of the Department of Health and Environmental Sciences (DHES). The permit would cover the mine, mill, and tailing sites, and would include all sources of emissions on the proposed permit area. The chief pollutant considered would be particulate matter.

Calculated levels must be within Montana's ambient air quality standards before a permit can be issued.

b. Water Quality Bureau

Anaconda has obtained from the Department of Health and Environmental Sciences' Water Quality Bureau a Montana Pollutant Discharge Elimination System (MPDES) permit, which would be required before waters from the mine adit could be discharged to State surface water such as the Stillwater River and its intermittent drainages.

Anaconda must construct and operate the proposed tailing pond in the Hertzler Valley so as to prevent water discharge, seepage, drainage, infiltration or flow that may pollute surface waters (ARM 16.20.633 [4]). The company must submit complete plans and specifications of the tailing pond to the Department of Health and Environmental Sciences no less than 180 days prior to initial construction.

The Department of Health and Environmental Sciences will probably issue new ground water regulations within the year. If so, Anaconda would have to obtain a permit for ground water discharge, in addition to the surface water permit already obtained, to cover the tailing pond in Hertzler Valley and the percolation ponds at the minesite.

6. Hard Rock Mining Impact Board

The Hard Rock Mining Impact Board (Hard Rock Board) created by the passage of House Bill 718 in 1980 is attached to the Montana Department of Commerce for administrative purposes. It is a quasi-judicial board intended to act as a "referee" in hearing disputes between local government units (for example, Stillwater County, the town of Columbus, and school districts) and large-scale mineral developers over the impact mitigation prepared by the developer plan. In the impact mitigation plan the developer identifies the increased public sector costs associated with major mineral development and commits itself to pay, according to a specified time schedule, all of the increased capital and net operating cost to local government units that will be a result of the development.

An operating permit issued by the Department of State Lands (DSL) for a large scale mineral development shall be conditioned to provide that mining may not commence until the Hard Rock Board approves the impact plan and until the permittee has provided a written guarantee to DSL and to the Hard Rock Board of compliance within the time schedule with the commitment made in the impact plan approved by the Hard Rock Board. If the permittee does not comply with that commitment within the time scheduled, the State Board of Land Commissioners, upon receipt of written notice from the Hard Rock Board, shall suspend the permit until it receives written notice from the Hard Rock Board that the permittee is in compliance.

The review of the impact plan by the Hard-Rock Board is intended to occur concurrently with the procedure for fulfilling the operating permit requirements.

7. Stillwater County

Stillwater County could adopt zoning regulations pursuant to 76-2-101 through 76-2-112 MCA (if properly petitioned) or 76-2-201 through 76-2-228 MCA that would control the location of the mill/tailing site. The county previously adopted a zoning regulation using the petition process that set up a planning and zoning district in southern Stillwater County. The regulation required that a zoning permit be obtained before an ore processing mill site could be located in the district. Although the proposed mill would not be located in an existing planning and zoning district, the county could expand the boundaries of the district to take in the proposed mill site or establish a new district.

B. SCOPING

The process of preparing an EIS on the proposed Anaconda Stillwater Project involved a public "scoping process" to identify issues to be addressed in the EIS. Two public meetings were held for this purpose: the first took place at the Beartooth Ranch near Nye, Montana, on September 15, 1981; the second was held at the Absarokee High School on September 16, 1981. About 130 persons attended the meetings.

The meeting agenda included presentations by Anaconda Minerals Company; the Department of State Lands; Camp Dresser and McKee, Inc. (the environmental studies consultants); Custer National Forest; and Stillwater County Planning Office. Following the scheduled presentations, public comments were received by the agencies.

In early September 1981, prior to the public meetings, over 500 pamphlets were mailed to interested persons by the Custer National Forest. These pamphlets listed potential impact-related issues and asked the public to comment on the significance of these issues, as well as to identify other issues. The pamphlets were also distributed at the Beartooth Ranch and Absarokee meetings and were made available at agency offices. Eighty pamphlets were returned to the Custer National Forest office within the comment period.

In addition to the pamphlet, newspaper articles appeared in local papers during August and September requesting public comments. Those persons returning the pamphlet or indicating an interest could request additional project information. In response to these requests, Custer National Forest mailed 194 EIS scoping documents during September 1981.

Following a review of the comments received at the public meetings, and in the the questionnaires, the impact-related issues were rated according to the significance placed on each by the public. A list of the identified issues and their rating as a result of the scoping

process is presented in table IN-1. Below is a list of the major issues that were raised. These issues focused on the concern that the proposed project might adversely affect certain resources or the social and economic conditions of the area.

(1) Water Quality. Would the project degrade the quality of surface and ground water by chemical contamination or contamination associated with increased population growth?

(2) Community Services. Would direct or indirect population growth associated with the project adversely affect area roads, schools, law enforcement, sewer and water systems, or similar community facilities or services? Would such community development and the need for housing financially burden "existing residents"?

(3) Reclamation. Would the company stabilize and successfully reclaim the areas disturbed by the project?

(4) Fisheries. Would the project result in decreased sport fishing opportunities, fish populations, and increased fishery management needs?

(5) Recreation. Would the project result in fewer recreational opportunities, lower quality of recreational experiences, or conflicts between recreation traffic and mine and mill traffic?

(6) Air Quality. Would the project degrade air quality during the development and operation phases of the project?

(7) Cumulative Mining Impacts. What would the cumulative mining impacts be as a result of potential operations by other companies exploring the Stillwater mineral complex?

(8) Wildlife. Would the project directly or indirectly disrupt or otherwise adversely affect wildlife populations, including the two endangered species found the project area--the bald eagle and peregrine falcon?

(9) Wilderness. Would the population growth associated with the project affect the wilderness recreation experience?

(10) Life Style. Would the project affect the current rural life style in the project area?

(11) Land Use. Would the project result in a change in the use of lands from agricultural to residential uses, particularly near existing towns?

(12) Scenic Values. Would the project conflict with maintaining the high scenic quality of the area?

In addition to the comments addressing the possible negative affects of the project, some comments were received that mentioned the

TABLE IN-1--Listing of the Issues by the Frequency of Their Being Mentioned

Frequency of Mention (#1 Most Frequent)	Issue No.	Issue[2]	Rating by Respondents: Significant or Highly Significant[3]	Of Concern	Not an Issue	Total Commenting
1	1	Water Quality (Hydrology)	34	8	5	47
2	2	Community Service (Community Services)	31	14	7	52
3	3	Reclamation (Geology, Hydrology, Soils, Veg.)	29	14	10	53
4	4	Fisheries (Aquatic Ecology)	27	17	10	54
5	5	Recreation (Recreation)	26	20	9	54
6	6	Air Quality (Air Quality)	25	20	9	54
7	7	Cumulative Mining Impacts (Geology)	24	11	18	53
8	8	Wildlife (Wildlife)	23	19	12	54
8	9	Wilderness (Recreation)	23	15	15	53
8	10	Lifestyle (Sociology)	23	17	19	59
9	11	Land Use (Land Use)	22	20	16	58
10	12	Scenic Values (Aesthetics, Recreation)	21	19	15	55
11	13	Transportation (Transportation)	7	0	0	7
12	14	Property Values and Housing (Community Services)	6	0	0	6
13	15	Use of Product (Chapter I)	3	0	0	3
14	16	Energy Demand (Chapter I)	2	0	0	2
14	17	Effects on Springs, Wells, Aquifers (Hydrology)	2	0	0	2
15	18	Effects on Cultural Resources (Cultural Res.)	1	0	0	1
15	19	Employment-Recruiting (Employment & Income)	1	0	0	1
15	20	Impacts on Other Businesses (Emp. & Income)	1	0	0	1
15	21	Political Changes (Sociology)	1	0	0	1

1 The numbers in the columns to the right display how many people commented on or brought up each issue.

2 Issues #1-12 were proposed in the pamphlet. Issues #13-21 were new suggestions. The section of the EIS in which each issue is discussed is listed in parenthesis.

project's potential postive affects, such as increased employment and property values.

Additional issues not discussed here are listed in table IN-1, and a more detailed discussion of the issues is available from Custer National Forest in either Billings or Red Lodge and the Department of State Lands in Helena. All of the issues raised, both those summarized above and those in table IN-1, guided the collection of data for the project and the analysis contained in this EIS in chapters II, III, and IV.

C. ADMINISTRATIVE ALTERNATIVES

After evaluation of this EIS, both DSL and the Forest Service have a number of administrative alternatives.

1. Department of State Lands

Five administrative alternatives are available to DSL: (1) approve the permit as proposed (2) take no action, (3) deny the permit, (4) approve the permit with modified mining or reclamation plans, and (5) approve the permit subject to stipulations.

a. Approve the permit as proposed

The environmental effects of approving Anaconda's permit as proposed are contained in chapter IV.

b. Take no action

If DSL were to take no action on Anaconda's permit, the permit could be approved by default (82-4-337 MCA). The environmental effects of this action are the same as approving the permit as proposed and are contained in chapter IV.

c. Deny the permit

The Department may deny the permit if the mining or reclamation plans violate the laws administered by the Department of State Lands or the water and air quality laws administered by the Department of Health and Environmental Sciences. DSL has consulted with the Department of Health and Environmental Sciences to determine whether Anaconda's proposed mining and reclamation plan would comply with the State's water and air quality laws.

The effects of denying the permit would be that the social, environmental and economic condition of the mine plan area and the region, including Stillwater County, would remain as described in chapter III.

d. Approve the permit with modified mining or reclamation plans

If the proposed plan were unacceptable, the Department could return it to Anaconda with a request that the company submit a modified plan for reclamation. In this EIS no major modifications have been identified that would significantly reduce the impacts of the mine or mill. Chapter II reviews the alternatives that were considered but ruled unreasonable.

e. Approve the permit subject to stipulations

If parts of the proposed plan were considered unacceptable, the Department could grant the permit with stipulations. Possible stipulations would include any modifications or additions to the proposed plans that the Commissioner considered necessary to meet the requirements of State Laws.

Possible stipulations that would reduce the impacts of the mine are listed, as separate sections at the end of each discipline, in chapter IV. These sections are titled "Mitigating Measures."

2. U.S. Forest Service

Four administrative alternatives dealing with the plan of operations will be considered by the U.S. Forest Service; they differ from those available to DSL: (1) no action, (2) approve the plan of operations as submitted, (3) approve a revised plan of operations with changes incorporated, and (4) disapprove the plan of operations. Approval of the plan of operations must be deferred until the EIS is prepared and a decision notice filed in the Federal Register.

If the plan of operations were approved, the Forest Service would periodically inspect operations to determine if Anaconda were complying with the approved plan. If (1) Anaconda were to fail to comply with the regulations or approved plan of operations and if the noncompliance were unnecessarily or unreasonably causing injury, loss, or damage to surface resources or (2) if the operation were not being conducted in a safe manner, the Forest Service would notify Anaconda in writing of the noncompliance, specify the action needed, and specify the time period for completing the action (36 CFR 228.7 and 36 CFR 228.9).

If Anaconda were not to comply within the time period given and did not appeal to the Regional Forester, the bond could be used for corrective action or the terms of the plan of operations enforced through civil action in Federal District Court.

a. No action

Under this alternative, the proposed plan of operations would be denied and, theoretically, no mining could take place; however, this alternative is not valid because under the 1872 mining law the national

forest lands on which the project would occur are open to mineral location and entry. Consequently, the Forest Service cannot take the "no action" alternative if Anaconda meets legal and policy requirements and takes reasonable measures to protect surface resources and public safety.

b. Approve the plan of operations as submitted

If the Forest Service agrees that the plan of operations is complete and adequate as submitted and no changes are required, the Forest Service would approve it.

c. Approve a revised plan of operations with changes incorporated

If the plan of operations as proposed were deemed generally acceptable but in need of some revisions, the Forest Service could require changes. These changes would be for management and protection of the surface resources of national forest system lands or public safety. They could not be aimed at managing mineral resources, for the Forest Service does not have the authority to regulate mining activities that do not affect either the surface resource or public safety.

Possible changes that would reduce the impacts of the project are listed, as separate sections at the end of each discipline, in chapter IV. These sections are titled "Mitigating Measures."

d. Disapprove the plan of operations

If the plan of operations were deemed unacceptable because of major environmental and or administrative constraints, the plan would be returned, stating the reasons for disapproval, and requesting that Anaconda submit a new plan that would meet all constraints.

CHAPTER I

DESCRIPTION OF THE PROPOSAL UNDER CONSIDERATION

The Anaconda Minerals Company proposes to operate a platinum/palladium mine and mill in the Stillwater Valley near Nye, Montana (fig. S-1, I-1, and I-2). An application for a mining permit was filed on August 17, 1981, to include a permit boundary of approximately 780 acres in two distinct areas. The mine complex encompasses approximately 90 acres and is located five miles southwest of Nye Junction. The mill/tailing complex lies approximately one mile northeast of Nye Junction and covers 690 acres. About 25 acres of the mine area lies on national forest system lands. The remainder of the permit area lies on private land.

1. Background of Project

The proposed operation lies in a geologic area known as the Stillwater Complex. The complex is an intrusion of igneous rock about 18,000 feet (5,488 meters) thick that outcrops over a 28-mile stretch of the Beartooth Mountains of south-central Montana.

The presence of oxide and sulfide minerals in the Stillwater Complex has been known since the 1880s and the demand for chrome for steel production during the first World War stimulated interest in the Stillwater Complex chromite deposits. This and other mineral development continued sporadically during the 1920s and 1930s and a number of claims were patented in 1933. The Stillwater Complex was first systematically explored for chromite deposits by the U.S. Bureau of Mines and the U.S. Geological Survey under the Strategic Minerals Act of 1939.

The Anaconda Copper Mining Company, at the onset of World War II, began underground development of chromite deposits near the proposed operation in 1941; concentrates were shipped from the Stillwater area until 1943. Operations ended in September 1943, when higher grade chrome ore was again available from foreign sources.

The American Chrome Company reentered the deposits in 1953 and produced chromite concentrates for the Federal government's strategic chrome stockpile until 1961. Part of the original 900,000-ton stockpile remains at a location near Anaconda's exploration office.

The platiniferous metals known to be present in the Stillwater Complex were of no economic significance until the 1970s. During that decade, the worldwide demand for the platinum-group metals exceeded supplies; the price of platinum increased by 308 percent to $400 per troy ounce, and Anaconda began pursuing the development of these mineral reserves.

In 1979 Anaconda Company applied for an exploration permit and obtained approval of a plan of operations to further define the mining potential of the Stillwater Complex project. Since issuance of the

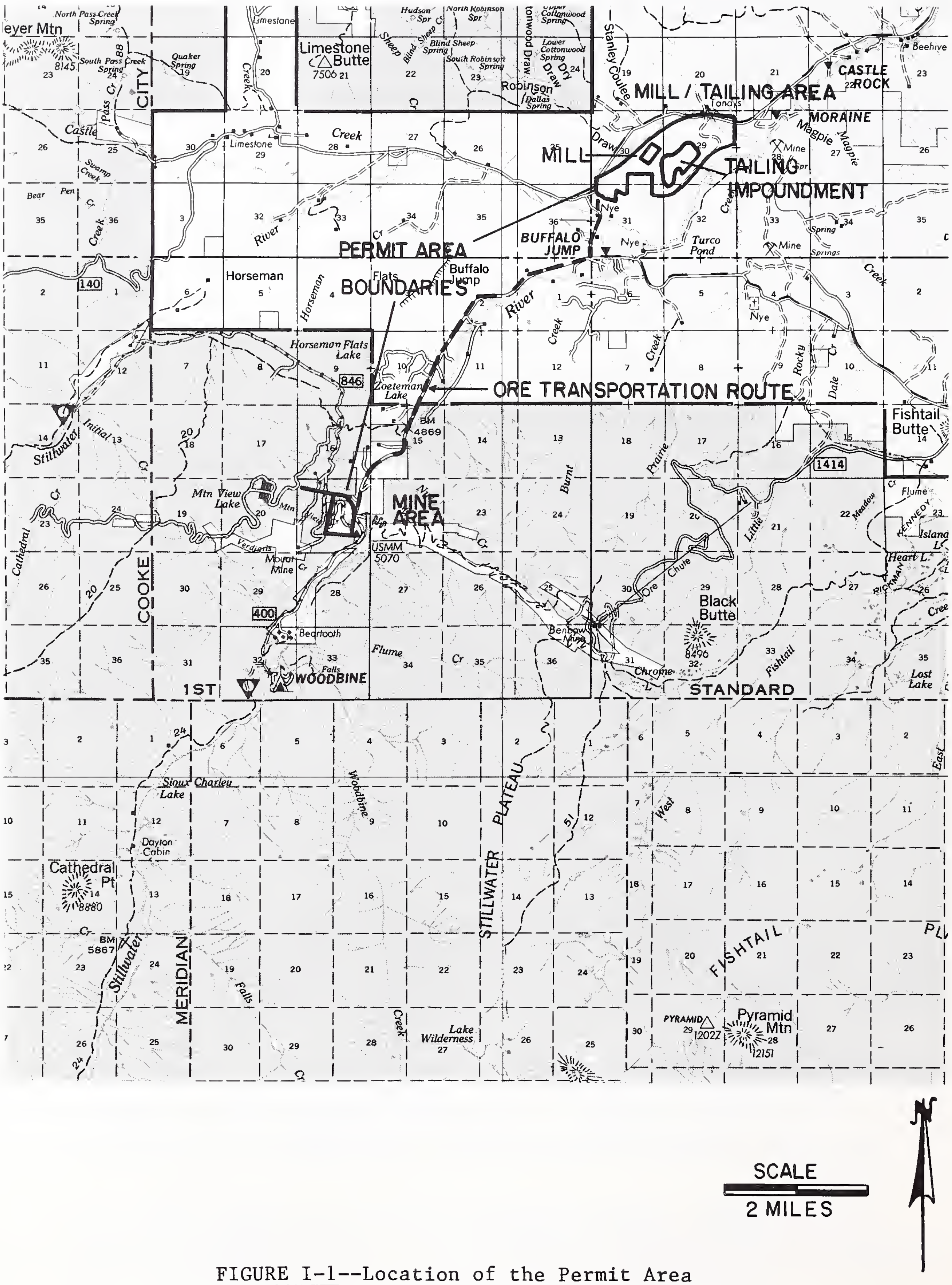


FIGURE I-1--Location of the Permit Area
(The shaded area is national forest system land.)

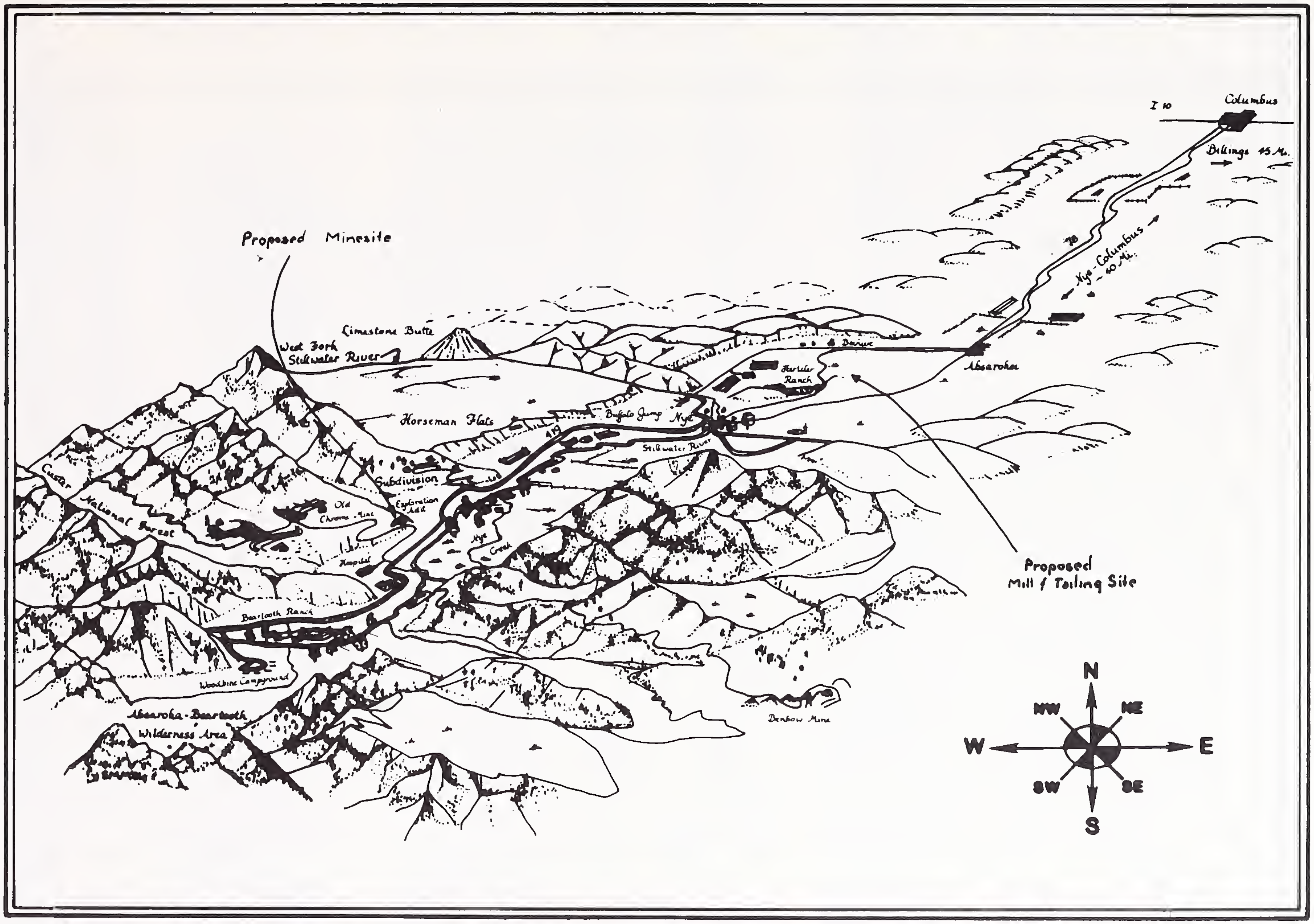


FIGURE I-2--Artists' View of Stillwater River Valley, Showing Project Area

permit, exploration activities have been performed at the existing Minneapolis and 1,980-meter-level adits. Under the exploration permit, drifts (horizontal tunnels) and raises (inclined tunnels) have been developed and bulk samples taken and analyzed. As a result of the preliminary findings of the exploration phase, Anaconda decided to continue the mining development and has applied for a permit to operate a mine and mill.

2. The Need for Platinum and Palladium

The single largest use of platinum-group metals is for catalytic converters in new automobiles. These metals are also used as catalysts in the chemical and petroleum refining industry, in electrical components, in jewelry, in medical and dental work, and in a variety of other manufactured goods (Naldrett and Duke, 1980, p. 1417; and July, 1978). The need for these metals in a number of industries derives from their high catalytic activity, inertness over a wide range of temperatures, and high melting points--a combination of properties found in no other metals (Jolly, 1978).

U.S. demand for the platinum-group metals is predicted to grow 3.0 percent annually, to about 3.1 million troy ounces, by the end of the century. If automobile catalytic converters that use platinum-group metals continue to be produced, the rate of growth would be much higher (Jolly, 1978).

The U.S. imports about 90 percent of its annual consumption of platinum-group metals. The remaining 10 percent comes from recycled sources within the U.S. A small amount of platinum-group metals are produced in the U.S. as a by-product of copper smelting. In addition, a large placer deposit in the Goodnews Bay district of Alaska produced platinum-group elements in significant amounts up until 1975 (U.S. Environmental Protection Agency, 1975, p. 270) and in July 1981 the R.A. Hanson Mining Company announced that it would reopen the Goodnews Bay mine (Engineering and Mining Journal, July 1981, p. 41). But at present the U.S. is almost totally dependent on foreign supplies for primary (nonrecycled) platinum-group metals.

The countries that currently satisfy most of the world's need are South Africa, the U.S.S.R., and Canada. The Republic of South Africa and the U.S.S.R. together account for 92 percent of world production. Canada produces another 7 percent. South Africa and the U.S.S.R. together possess more than 97 percent of the world-platinum-group metal reserves (Naldrett and Duke, 1980, p. 1417).

The Anaconda Stillwater Project would provide an estimated three percent of the United States' need for primary platinum and seven percent of the need for primary palladium (Jim Harrower, Anaconda Minerals Company, oral commun., February 1982). Although a small percentage of the whole, this would ease the Nation's total dependence on foreign sources. This could be especially critical from a strategic viewpoint, since a supply disruption at present would leave the U.S.

with no developed sources of primary (nonrecycled) platinum-group metals.

3. Mining and Milling Plan

The following description of Anaconda's proposed operation is based on information contained in the company's permit application and plan of operations as submitted. Copies of this application can be reviewed at the Montana Department of State Lands (DSL) in Helena, the U.S. Forest Service's offices in Billings and Red Lodge, and the Stillwater County Planning Office in Columbus.

a. General operations

The target of the company's proposed operation are the platinum and palladium within the igneous rocks of the Stillwater Complex. The ore contains less than one-half troy ounce of platinum-group metals per ton. Other precious metals included are minor amounts of gold and silver.

1) Mining methods

The proposed mining method is shrinkage stoping (fig. I-3), a method used in steeply dipping mineral veins where the surrounding rocks provide strong walls. The ore would be mined in successive flat or inclined slices working upward from underground passages. After each slice is blasted down, enough broken ore would be removed from below to allow working space between the top of the pile of broken ore and the bottom of the unbroken ore zone.

Underground excavations, or stopes, would be developed in pairs, each 197 feet high by 397 feet long. Five pairs of stopes would be worked at one time. At each end of a "double stope" a passageway would be advanced to provide access, ventilation, and services. Vertical support pillars 40 feet (12 meters) long would be left between stope pairs and a supportive (crown) pillar would be left between the uppermost mining horizon and the surface.

Passageways would be horizontally excavated at 197-foot vertical intervals. Through these passageways the ore and waste rock would be hauled via the Minneapolis adit to the surface. Mining would proceed from top to bottom and generally from west to east. The development phase of the operation would occur over a period of approximately 30 months, including about 15 months for shaft development and 15 months for mining level development. Mining as proposed would begin in early 1985.

2) Underground facilities

In addition to those facilities described above, the underground operations would include electrically powered hoists for men and equipment; a transportation system for personnel, equipment, supplies, ore, and waste rock; and a water discharge system. The hoists would be

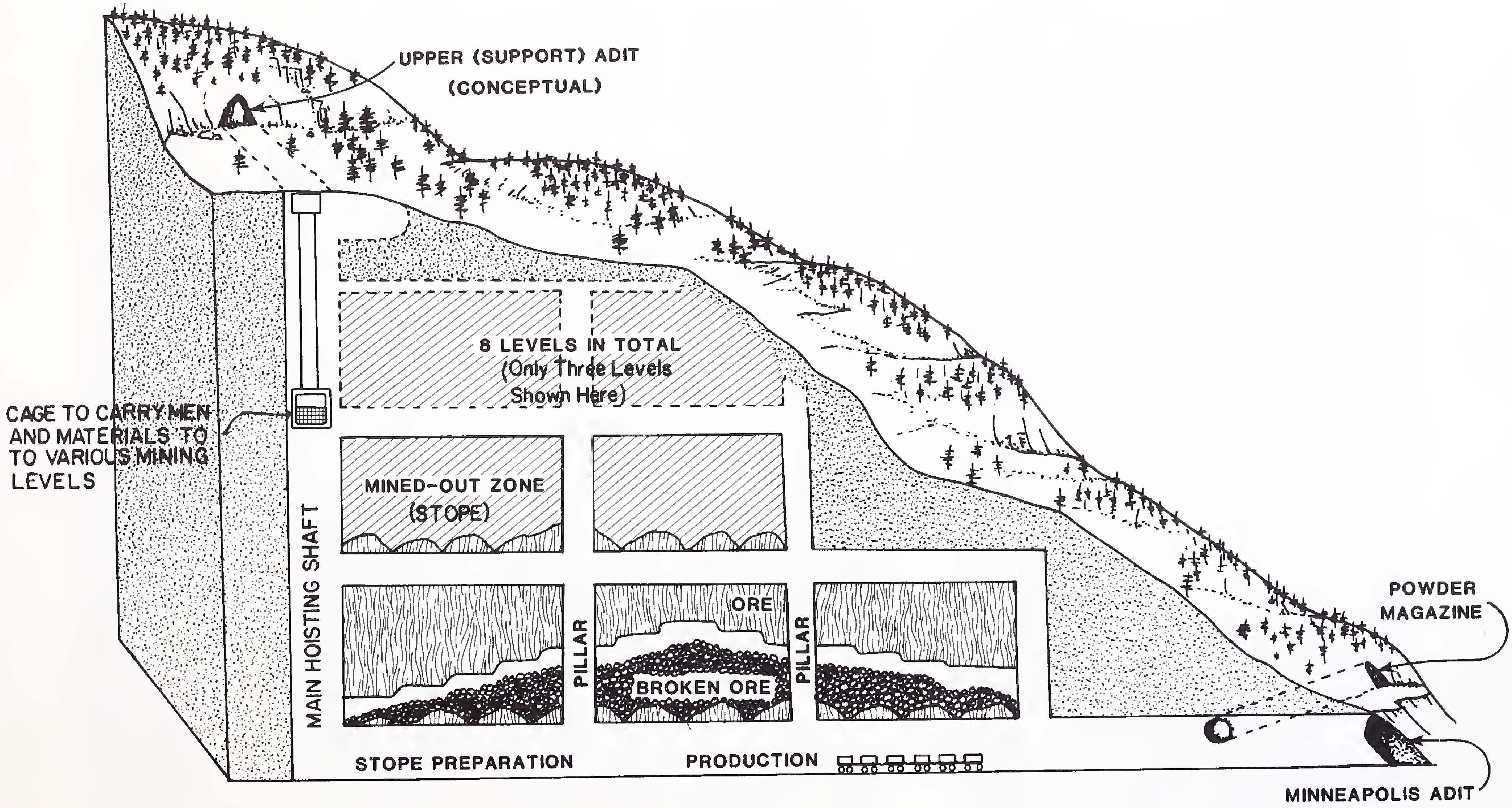


FIGURE I-3--Simplified View of Mining Method

located at the support adit and the associated vertical shafts. The propane distribution pipe system would be used for mine air heating. The transportation system would be Granby-type electric mine cars.

3) Ore production and handling

Production of ore is expected to average 1,000 tons per day and peak at 1,200 tons per day. Ore would be transported from the adit using automatically dumped (Granby-type) mine cars to the primary crusher dump pocket. The dump pocket is located on Anaconda Minerals Company land between the portal and waste rock dump and has a capacity of approximately 100 tons. (See fig. I-4.)

Should ore stockpiling become necessary due to temporary problems with the crusher, an emergency stockpile would be located on the waste rock dump adjacent to the ore dump pocket. A ramp from the emergency stockpile to the dump pocket would then be constructed to provide access for front-end loader transportation of the ore back to the dump pocket. Ore would be transported 24 hours a day, seven days a week to the mill in 20- to 25-ton highway trucks on county road FAS (Federal Aid Secondary) 419 and 420 (figure I-1) and would run at approximately 30-minute intervals. It is estimated that 50 to 60 loaded trucks and 50 to 60 empty return trucks would use FAS 419 and 420 from the mine to the mill daily.

4) Surface facilities

Three surface openings would be utilized for the Stillwater Project: the Minneapolis adit (5,180 feet of elevation), the 1980-level adit (6,530 feet of elevation) and a powder magazine (6,530 feet of elevation). (The 1980-level adit is so called because it is at 1,980 meters of elevation.) The two adits are now in place on national forest land, constructed under approved exploration operating plans and permits submitted in 1979-1981. (See fig. I-5.) The Minneapolis adit (9 feet x 11 feet) would be used as the main working entrance to the mine and would allow access for miners, equipment, and supplies. Ore and waste rock would be transported to nearby Anaconda Minerals Company land from this opening. The 1980 level (11 feet x 11 feet) would provide an emergency escapeway, an airway for exhaust ventilation, and a water supply line. The powder magazine would be used for storage and transport of explosives. It would consist of a tunnel and room excavated in the rock face beside the Minneapolis adit. The size of the magazine is expected to be 12 feet by 12 feet; the exact dimensions would be determined later. Mine ventilation would be provided by one main exhaust fan within the 1980 level: air would be brought in the Minneapolis adit, would circulate through the various working levels, go up the service shaft, and exhaust from the 1980 adit. The ventilation fans would be electrically powered. In those instances where short-term ventilation is needed or electricity is not available, diesel-powered air-driven fans would be used.

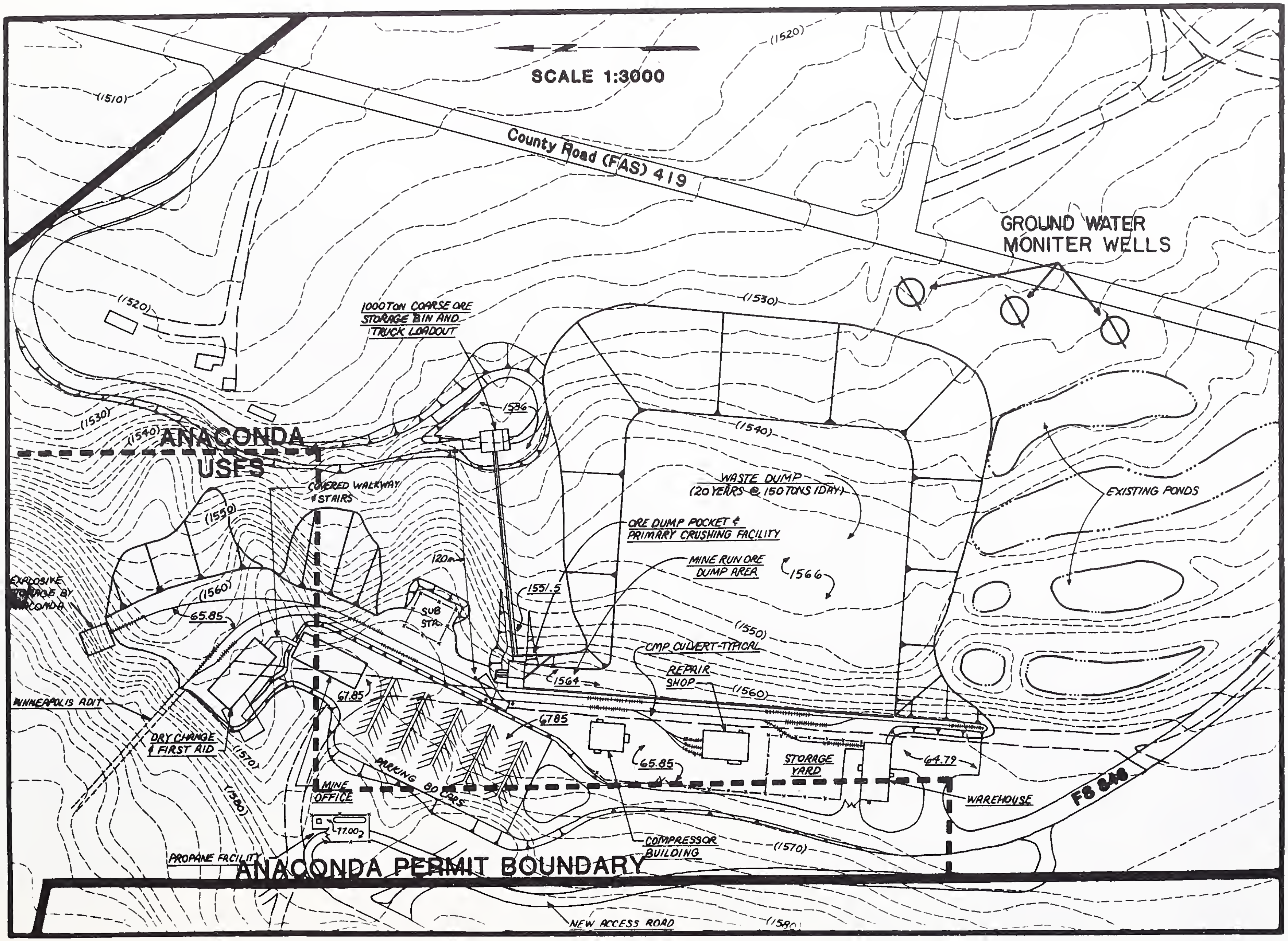


FIGURE I-4--Approximate Minesite Layout (Section 21, T5S, R15E)

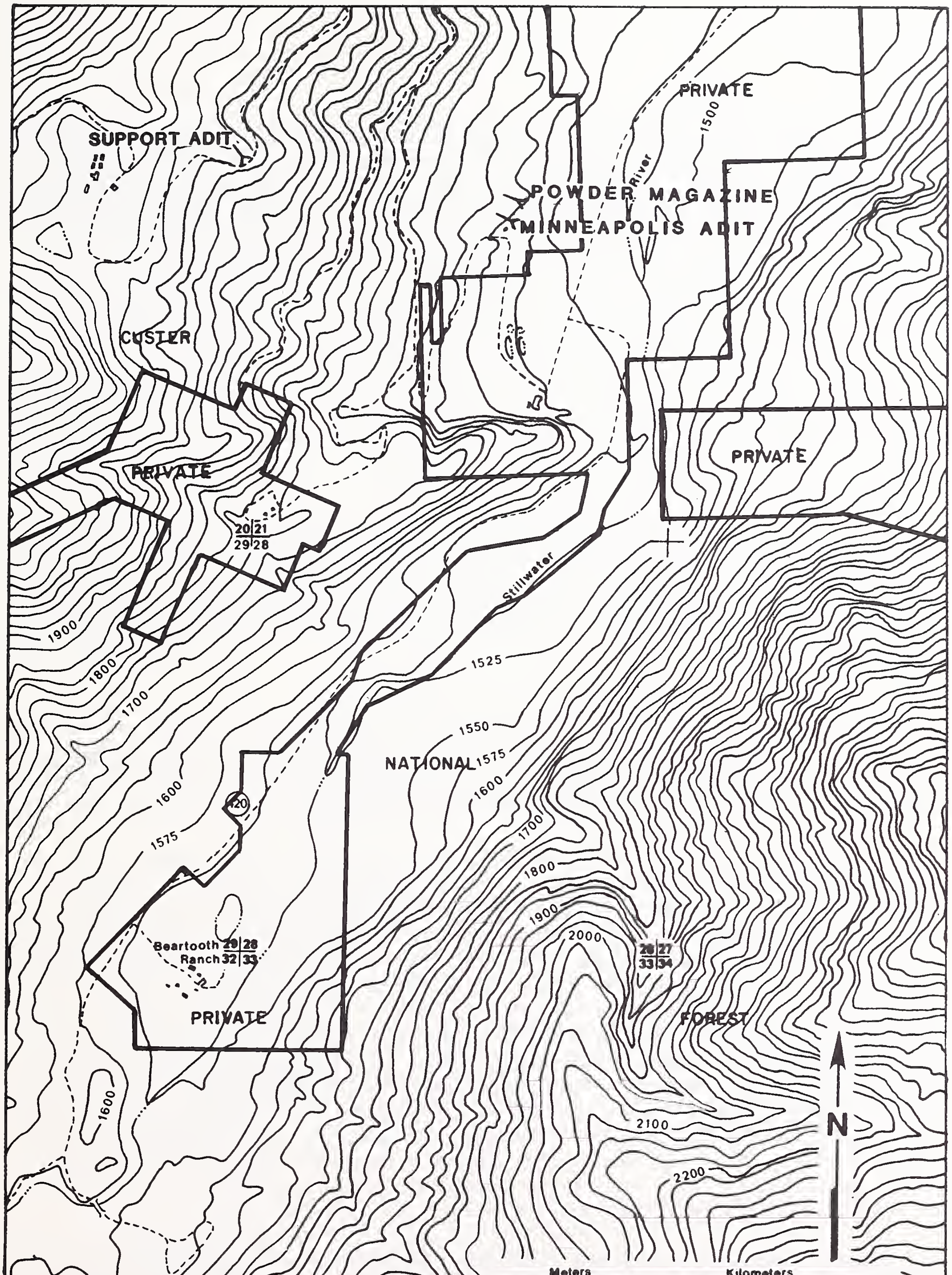


FIGURE I-5--Location of Mine Adits and Land Ownership in Vicinity of Proposed Mine (T5S, R15E)

Buildings would include the mine office building, the dry change and first aid building, the repair shop, compressor building, propane storage facility, substation, storage bin, ore crusher, and warehouse. In addition, a storage yard, 80-car parking lot, and two support roads would be built and a section of Forest Service Road 846 would be relocated. (See fig. I-4.) Construction efforts would begin after obtaining all required government approvals and final approval of the Atlantic Richfield Company (the parent company of Anaconda Minerals Company). Construction would continue for approximately 30 months.

Waste rock--rock of too low a grade to warrant processing--would also be transported from the mine in Granby-type mine cars. These cars would run on a 150-foot slide track to the waste dump, which would be on private land. The waste rock would be deposited over a 6-foot concrete retaining wall onto the dump.

The waste rock dump is designed to hold 150 tons per day of waste rock for twenty years. At this production rate of waste, the dump track would have to be relocated in the third year of operations. A second relocation would occur in the eighth year. Since the production rate of waste rock would remain constant, the waste dump would grow at a constant rate.

5) Utilities for mining operation

Utility requirements for the proposed mining operation include electric power, telephone, propane system, potable water, sewage treatment, solid waste disposal, and waste water disposal.

Electric power would be supplied by an existing 50 kV line with a possibility of upgrading to 69 kV. Telephone service would be provided using the existing system, and a new underground cable would be installed from the town of Nye to the minesite. Potable water requirements would be provided by ground water wells located approximately 1,000 feet southeast of the Minneapolis adit. These wells are capable of producing approximately 75-100 gallons per minute (gpm). Anaconda estimates that roughly 100 gallons a minute would be needed to operate the mine and supply water for the mine facilities. Some of the required water would come from adit discharge. Obtaining water from Mountain View Lake for mining operations may be necessary in the future. Securing the water right would be required. The lake and the supply line are not in the current permit area, and the permit would have to be amended to include them. Solid waste (e.g., domestic trash) would be disposed of by using the Stillwater County "green box" system.

Domestic sewage resulting from the mining operation would be handled using an aerobic sewage treatment plant. This plant is a factory-built system that offers primary, secondary and, optionally, tertiary sewage treatment.

Water produced from the adit would be directed toward a series of percolation ponds. These ponds have a designed treatment capacity of

2,000 gpm, well above anticipated requirements. To date, discharge from the Minneapolis adit has not exceeded 300 gpm. The ponds are operated under the purview of the Montana Pollutant Discharge Elimination System (MPDES) permitting process. They are a major component of the water handling system approved for Anaconda's exploration adit activities.

6) Surface water control

The surface water drainage system necessary for the operation of the mine includes minor diversions from parking lots and other surfaces. This system would use natural surface percolation to avoid water accumulation.

7) Operating schedule

The mine would operate on a 24-hour-per-day schedule for 350 days per year. A labor force to staff four full shifts (weekends included) would be needed. The day shift (Monday through Friday) would normally include 74 employees; the night shifts would include 32 employees. Weekend shifts would also use 32 employees. The number of employees would total about 160 people per day during the week and 125 people per day on weekends.

The company does not contemplate building employee housing. The labor force employed would probably reside in established communities. It is anticipated that the town of Absarokee would accommodate the majority of the people. Wages paid to the mine employees would be competitive with similar industries in similar locations.

b. Transportation

Access to the minesite and support facilities would be from FAS 419 and would consist of a haul road to the ore load-out and an access road to the main part of the mine. Anaconda would build new roads required for the project and would be involved in the funding of existing road improvements. The only new roads planned are those needed for access to the various facilities within the proposed mine permit area. Most of these roads are on private lands. These new roads would be paved with a minimum of 2 inches of asphaltic concrete over a minimum of 4 inches aggregate base. The sub-base thickness would vary depending upon the precise location of the road. Road width would average 24 feet with 2- to 4-foot shoulders.

The county road (FAS 419 and 420) between the mine and mill would be improved by Anaconda to accommodate the required truck traffic and to provide for public safety. The road would be repaved and bridges would be upgraded as necessary. Widening of the road (other than to accommodate paving) is not anticipated. The improvement would not encroach on the Stillwater River. A short segment of FAS 419 would have to be relocated because of the waste dump. (See fig. I-4; the relocation is not shown.) It is anticipated that all other improvements can be accommodated within existing rights-of-way.

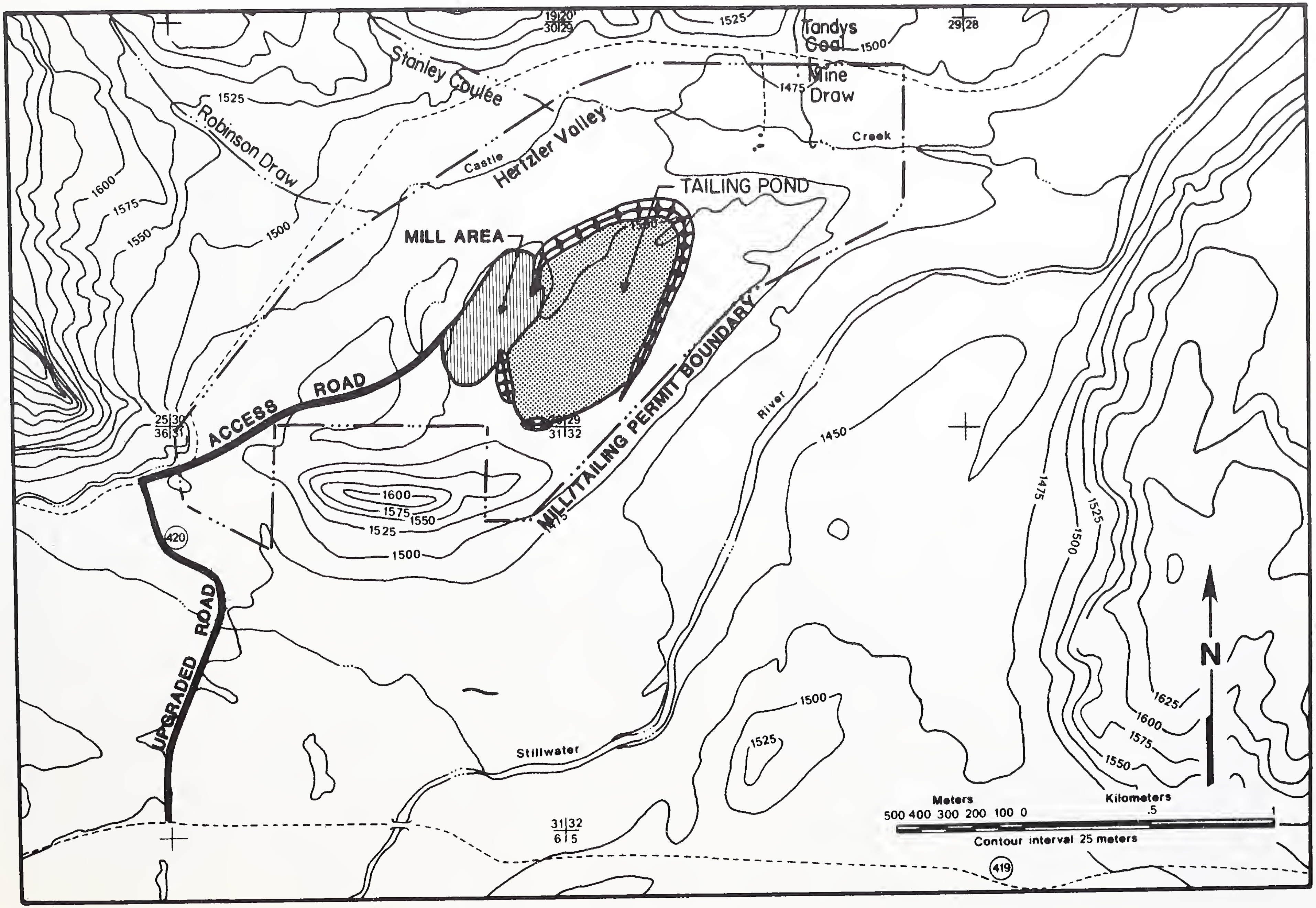


FIGURE I-6--The Mill and Tailing Area

c. Mill and tailing impoundment

1) General operations

The mill is proposed to be located in section 30, T4S, R16E of Stillwater County; the tailing impoundment would be directly to the east and adjacent to the mill (fig. I-6). The permit area covers approximately 690 acres.

The finely crushed ore fed into the mill and concentrator would average about 1,000 tons per day. Production of concentrate from the mill concentrator would be 15 tons per day. This figure represents a raw milled product containing approximately 0.5 troy ounce of precious metals per ton of ore (500 ounces per day) as well as the associated carrier substances. Roughly 98 percent of the original ore rock that is processed would end up in the tailing pond and be permanently stored there.

2) Milling process

Upon arrival at the mill (fig. I-7), the ore would undergo secondary crushing prior to conventional grinding. Following grinding, a standard flotation process would be used to extract sulfide minerals containing the precious metals from the bulk of milled material. (See appendix 2.) The concentrate would be filtered, dried, and containerized.

A total of 400 gpm of water would be used for the milling process, with 300 gpm being recycled water from the tailing impoundment. The remaining 100 gpm would be lost through seepage and evaporation and would have to be replaced from an alternate source (make-up water). Make-up water requirements would be obtained from a combination of a well and a surface water diversion. The well would likely be located in the NE 1/4, section 30, T4S, R16E. The surface diversion would be from the West Fork of the Stillwater River via an existing irrigation ditch (NW 1/4, section 36, T4S, R15E). Both of these water sources would require permits under Montana water appropriation laws. Overflow water from the tailing process would be pumped to the mill head tank for reuse; underflow (thickened tailing) would be pumped to the tailing disposal area. A reclaim barge would be located in the tailing disposal area to recycle water for process use.

Reagents that would be used for the milling process and their approximate rate of use are copper sulfate (16.7 pounds per day), potassium amyl xanthate (91.1 pounds per day), carboxy methyl cellulose (555.5 pounds per day) and polyglycol ether (as needed). Copper sulfate would be stored in 100 pound bags; the potassium amyl xanthate and polyglycol ether would be stored in metal drums; and the carboxy methyl cellulose would be stored in an enclosed unit furnished by the reagent's manufacturer.

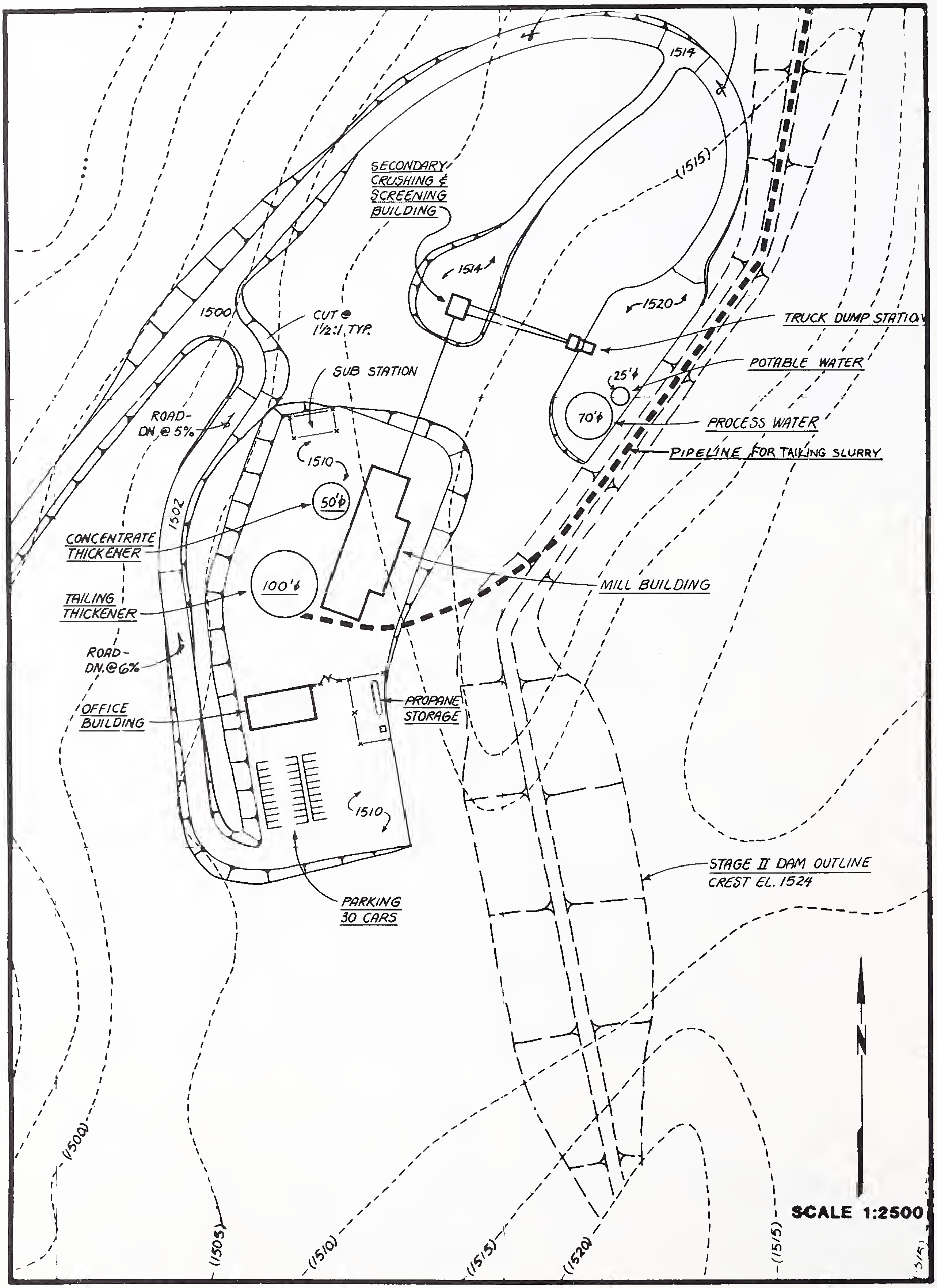


FIGURE I-7--Layout of the Mill Site

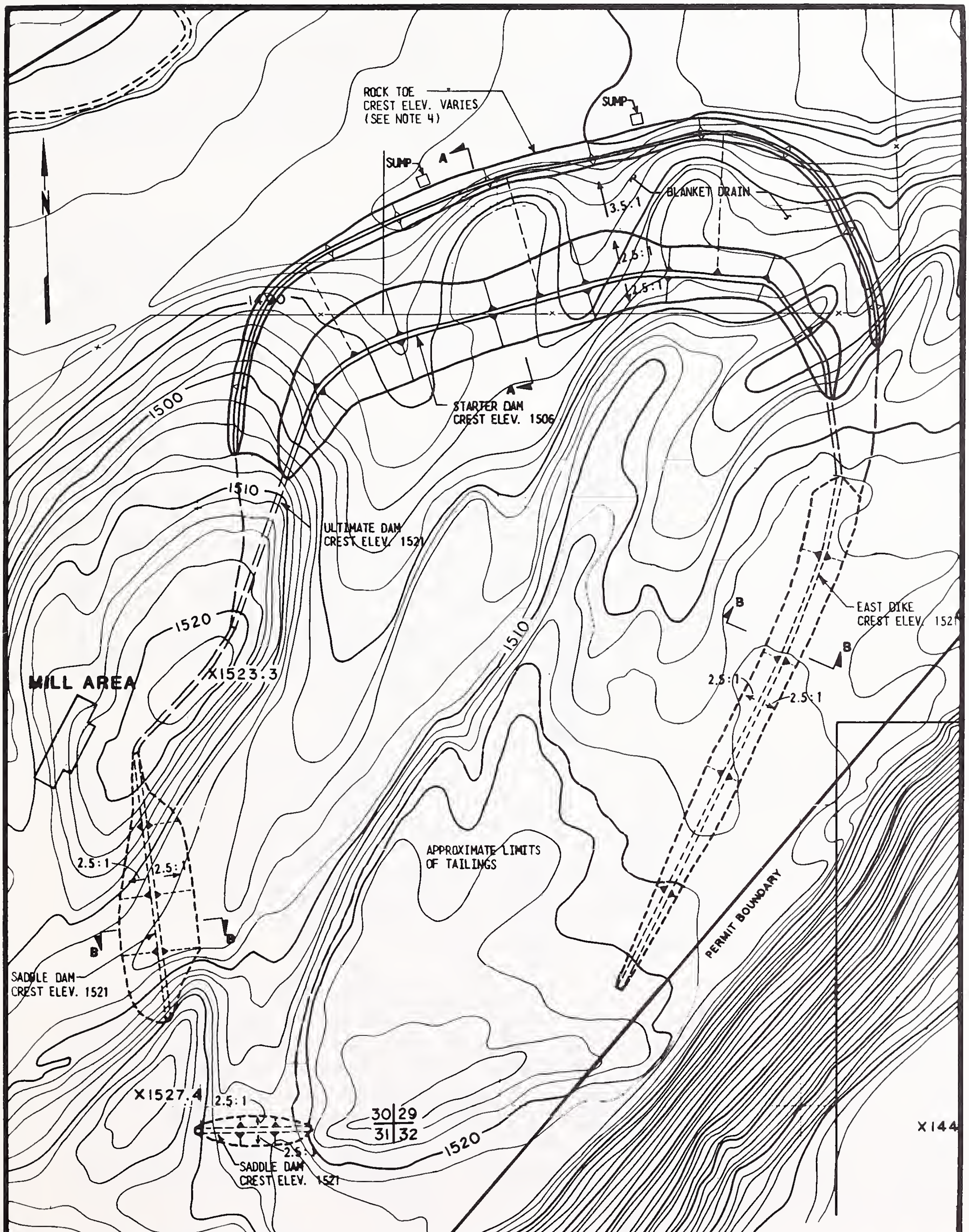


FIGURE I-8--Layout of the Tailing Site

Of these reagents, most of the copper sulfate, potassium amyl xanthate, and polyglycol ether would remain with the milled product. Some would stay with the tailing water. (See appendix 2.) A large majority of the carboxyl methyl cellulose would also remain with the tailing water. The tailing water would end up in the tailing pond.

3) Tailing impoundment

The tailing impoundment is designed to contain 7 million tons of material (20 years production at 350,000 tons per year) and would provide permanent storage of tailing from the concentrator (fig. I-8). About 1,185 tons dry weight of tailing would be sent to the tailing pond each day. The surface area of the impoundment would be approximately 113 acres.

A starter dam, a blanket drain, and a rock toe barrier would be built prior to the processing of any ore at the mill. The starter dam would be constructed using earth material collected from the interior of the tailing impoundment. The final volume of the starter dam would be 300,790 cubic yards. The final elevation of the starter dam would be 4,895 feet and be a maximum of 65 feet above the preexisting landscape. A 2-foot-thick blanket drain composed of material larger than coarse sand would be placed between the starter dam and the rock toe. The blanket drain along with the rock toe would be drained by two sump pumps located just outside the rock toe. This would reduce the saturation and thus increase the stability of the main tailing dam to be built over the top of the starter dam and blanket drain. (See fig. I-9.)

Tailing slurry from the mill would be piped to the north end of the tailing impoundment. The slurry would leave the concentrator as approximately 50 percent solids. The sand-size fraction of the tailing, separated from the rest of the tailing by a cyclone separator, would be used to build the main tailing dam. The finer tailing and slurry water removed by the cyclone separator would be piped to the south and discharged into the tailing impoundment. The tailing dam would be gradually raised as tailing filled the impoundment. Water in the slurry would be recycled back to the mill for reuse.

The distribution line and cyclone separator would be moved back and forth across the tailing dam to raise the elevation of the dam. The top of the tailing dam would remain centered over the starter dam as it is raised. The top of the main dam would stand a maximum of about 100 feet above the preexisting landscape. The dam crest elevation would be 4,990 feet. The upstream slopes (facing uphill) and downstream slopes (facing downhill) of the starter dam and other earthfill dams would be 40 percent (2.5 horizontal to 1 vertical). A downstream slope of the main tailing dam would be 29 percent (3.5 horizontal to 1 vertical) for stability and reclamation purposes.

About the sixth year of milling, a small dike would be constructed along the eastern margin of the tailing impoundment. This dike would

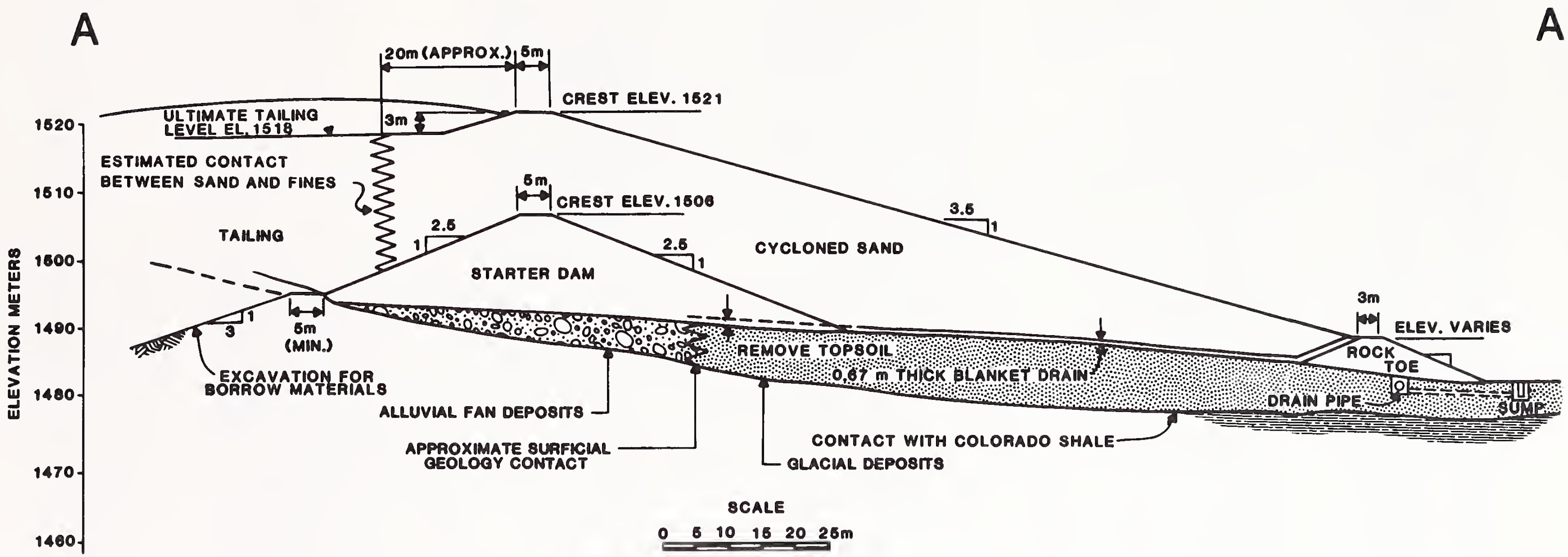


FIGURE I-9--Cross Section of Tailing Dam

have to be built so that the elevation of the impoundment could be raised above 4,915 feet. Two small saddle dams would also be built along the southwestern edge of the tailing impoundment to raise the elevation of two small drainages high enough to contain the tailing. The southwest saddle dam would be built in year 4. The smaller southern dam would not be needed until the last few years of milling.

Water collecting on the surface of the tailing impoundment would be collected by a floating barge pumping system located at the southern end of the impoundment. This water would be pumped back to the mill for reuse. Some water would percolate downward through the tailing (estimated to be about 100 gallons per minute). Most of this water would be captured by the ground water collection system located under the main tailing dam. Two sump pits located along the northern edge of the main dam would have pumps in them to draw in this water and pump it back to the impoundment.

4) Surface support facilities

The surface support facilities proposed for the mill complex include the mill office and dry change building, the mill building, the secondary crushing and screening building, access road and truck dump station, process water tank, potable and fire water tank, propane storage area, electric substation, concentrate and tailing thickener tanks, parking areas, and entrance road. The access road, entrance road, dump station, and parking areas would be paved.

5) Transportation

An access road to the mill yard area and miscellaneous roads within the yard would be constructed. The access road would be approximately 0.75 miles long and would connect to the county road (FAS 420). Construction techniques would be as outlined for the mine area.

After the ore is processed, four truckloads per week of concentrate would be trucked to Columbus for shipment by rail to various market locations.

6) Utilities

Proposed utilities for the mill include a powerline from the substation southeast of Nye Junction, an electric substation, a well for potable and make-up water, a telephone line to be connected to existing lines, a pre-engineered aerobic sewage treatment plant, and a Stillwater County regulated "green box" solid waste system.

7) Surface water control

Surface water runoff from the contributory drainage areas (including the mill area) would be directed toward and stored entirely within

the tailing impoundment. The impoundment dam would be maintained at all times to be at least 7.6 feet above the water surface; the pond would hold the maximum amount of tailing process water and the runoff from the largest 500-year, 24-hour rainfall event (11 inches) and still maintain 7.6 feet of freeboard.

8) Operating schedule and employment

The mill would operate 24 hours per day, 350 days per year. The staff requirements would be for four full shifts to accommodate weekdays and weekends. The day shift (Monday through Friday) would require ten employees; the night and weekend shifts would be staffed by seven employees per shift. Housing and wages would be as described for the mine operations.

4. Surface Ownership

All of the land covered by the mill/tailing part of the permit area lies on private land. Ninety-seven percent of the mine part of the permit area lies on private land. The remaining property is national forest system lands. Existing facilities at the minesite that lie on national forest land include the main adit, the 1980-level adit, Forest Service Road 846, and the workshop adjacent to the Minneapolis adit. These were analyzed and permitted through environmental assessment reports completed for the operating plan for prospecting (on file with Beartooth Ranger District, Custer National Forest).

New facilities and surface disturbances associated with the mine that would be entirely or partially on national forest system lands are listed below. (See also fig. I-4. The locations of the facilities and disturbances are approximate, based on conceptual engineering plans. There may be some locational adjustments when specific site plans are completed.) Those listed as previously disturbed are those areas already having been disturbed either by Anaconda's exploration or by previous mining activity.

Structure	Scope of Disturbance
1. Explosive storage	new disturbance
2. Dry change/first aid	on previously disturbed area
3. Office	on previously disturbed area
4. Propane facility	new disturbance
5. Eighty-car parking lot	on previously disturbed area
6. new access road	new disturbance
7. Road from ore bin to FAS 419	new disturbance
8. Road to parking, storage, and warehouse from road 846	new disturbance
9. Warehouse	on previously disturbed land
10. Storage yard	on previously disturbed land
11. Mine track	on previously disturbed land
12. FS 846 relocation	new disturbance

5. Summary of Reclamation Plan

Additional detailed information about Anaconda's proposed reclamation plan is contained in the company's permit application and plan of operations, on file with the Department of State Lands in Helena, the Forest Service in Billings and Red Lodge, and Stillwater County Planning Office in Columbus.

The life of the mine is proposed to be 20 years. The following year Anaconda would begin reclamation of the permit area such that the postmining landscape would provide wildlife habitat and be directed toward recreational and agricultural activities.

Anaconda is required to file a bond with the Department of State Lands of not less than $200 or more than $2,500 for each acre disturbed. Despite these limits, however, the bond must not be less than the estimated cost to the State of reclaiming the disturbed lands.

The Forest Service may require additional bonding if the Service feels that the bond held by the Department of State Lands is not adequate for reclamation of national forest lands or available for Forest Service performance requirements. The bond amount would be equal to or greater than the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations on national forest system lands. The bonding level would be adjusted if the plan of operations were modified.

a. Mine reclamation

1) Underground mine

Any salvageable material (e.g. exhaust fans, rails) would be removed from the underground portion of the mine. Nonsalvageable materials (e.g. timbers, rail ties, gates, pipes, etc.) would be left underground.

2) Surface facilities

All adits would be sealed and abandoned in compliance with applicable State and Federal regulations. Specific sealing methods are now being discussed with Anaconda. All structures, unless deemed to have a continued beneficial use, would be dismantled upon completion of mining operations. Salvageable materials would be hauled away to the appropriate markets; nonsalvageable materials, such as concrete and asphalt, would be buried or covered at the site or disposed of at an approved disposal site. Any toxic materials would be disposed of at disposal site approved by the Montana Department of Health and Environmental Sciences.

3) Recontouring

Those cut and fill areas created during construction, as shown on

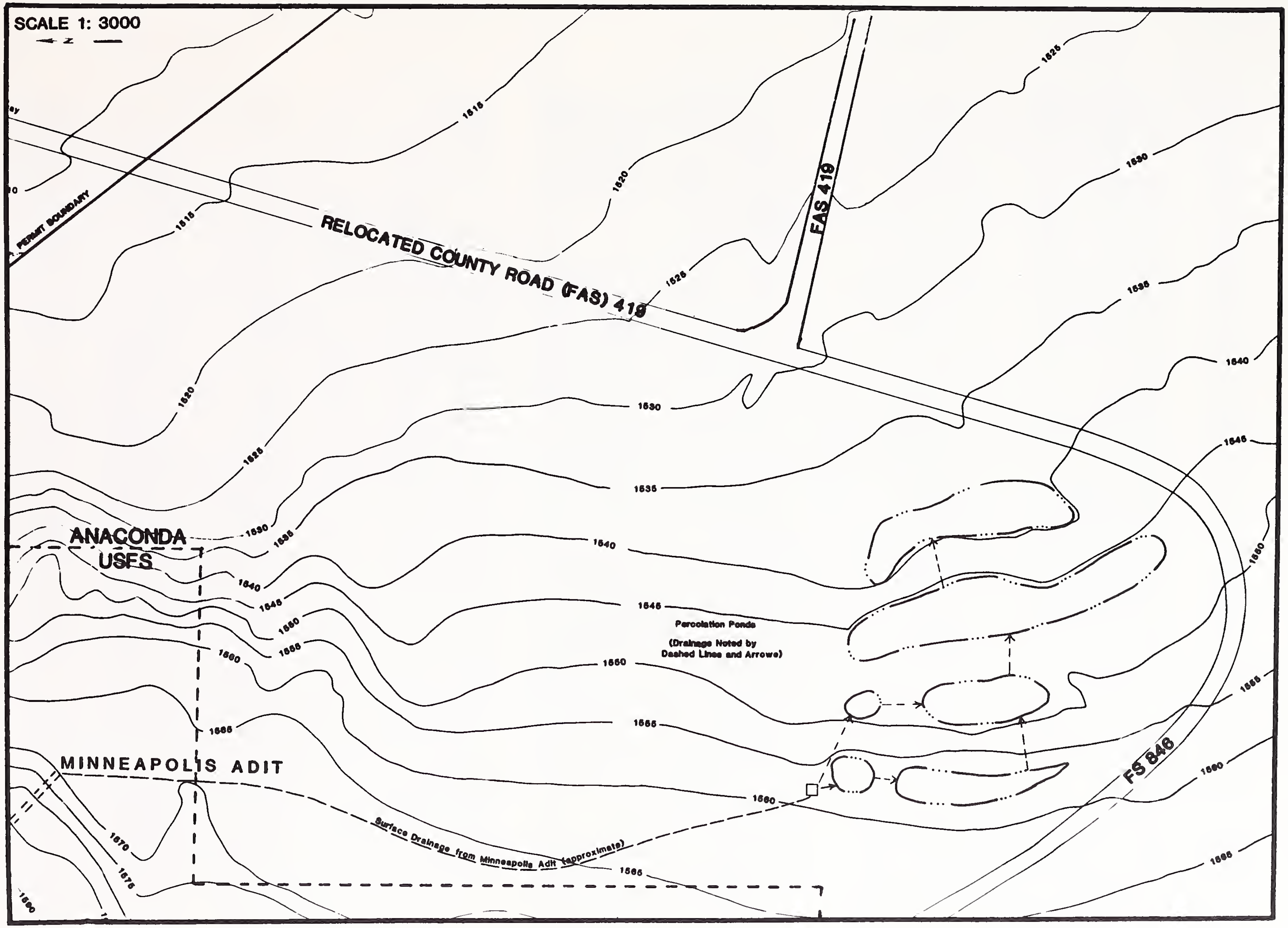


FIGURE I-10--Postmining Topography of Minesite, Showing Percolation Ponds

figure I-4, would be topsoiled and revegetated immediately following construction activities.

Fifty-three percent (364,000 cubic yards) of the waste rock stored at the minesite would be transported to the mill site for reclamation purposes. The remaining 324,000 cubic yards of waste rock would be recontoured to an average slope angle of 12.5 percent (8 to 1 slope gradient). An average of 4.5 inches of soil would be placed over the waste rock. The final topographic configuration of the mine area is shown in figure I-10.

Drainage from the Minneapolis adit would continue to be handled by the percolation pond system. Water would drain from the adit through a surface ditch to the ponds. These ponds were designed to be a self-maintaining system and hence would require no specific maintenance efforts.

4) Topsoiling and revegetation

Where practical, all available undisturbed surface soil would be stripped and stockpiled at the mine area during the development phase. The company has estimated the available soil volumes to be approximately 10,000 cubic yards (7,646 cubic meters). All stockpiles would be graded to have maximum 3:1 (33 percent) side slopes and would be seeded and managed to prevent wind and water erosion of soil material. The seed mix proposed would contain intermediate wheatgrass (Agropyron intermedium), Western wheatgrass (Agropyron smithii var. rosana), pubescent wheatgrass (Agropyron trichophorum), slender wheatgrass (Agropyron trachycaulum), and yellow sweetclover (Melilotus officinalis). This mixture would be drill seeded in equal proportions at a rate of approximately 30 pounds of per live seed per acre.

Stockpiled soil would be spread to an average depth of 4.5 inches on all disturbed areas and on the rock material remaining at the waste dump. Other respread soil depths are also being considered by the company. This soil material would provide a seedbed for revegetation.

Waste rock would be used as a subsoil. The size distribution of the rock material is variable, but upon regrading is expected to be reduced to an average size of 2 inches in diameter. The company is currently having good success with revegetation of the old chromite mill site, using waste rock as the only growth medium; however, this site has been irrigated since 1979. Where possible, the company would also irrigate the proposed disturbance areas.

For disturbed areas other than the waste rock surface, preparation techniques would include ripping and grading to provide a contact surface suitable for the respreading of topsoil material.

Once the topsoil is spread, the areas would be seeded with the mix listed in table IV-4. Seeding would be done in early spring or late fall and application rates would be approximately 20 to 25 pounds pure

live seed (PLS) per acre if drilled and 40 to 50 pounds PLS per acre if broadcast.

Actual fertilization rates would be governed by soil tests of the stockpiled topsoil. Prior experience of the company in the area suggests that a 10-16-0 fertilizer is appropriate. An application of 100 pounds per acre is anticipated; however, actual rates of fertilization would depend on specific soil tests. Addition of lime is not expected to be necessary.

All topsoiled areas would be mulched. The type of mulch selected for use would be appropriate to fulfill the specific needs of each situation. It is expected that excelsior mat would be utilized on the most difficult erosion and revegetation areas, and hydromulch would be used on moderately difficult revegetation areas. Jute netting, straw and net, or other similar materials may also be used as deemed appropriate. Straw mulch would be used on all other areas.

The reclamation plan proposed by the company states that the final vegetation establishment would be of comparable cover density to that of similar surrounding areas. The plan also states that, because of the comparable cover, surface soil erosion rates would be similar to natural erosion rates on typical natural slopes in the area having similar steepness and aspect.

5) Surface and ground water drainage

Disturbed areas would be regraded and revegetated once mining is completed. The regrading would use existing surface drainages and natural percolation to avoid the impoundment of surface water runoff.

Drainage of ground water from the adit would be accomplished through the existing drainage pond system as described previously. The pond system is permitted under the Montana Pollutant Discharge Elimination System (MPDES) regulatory framework under MPDES permit MT-0024716. During and after successful reclamation, these percolation ponds would have to meet the requirements of this permit or subsequent permits.

6) Roads

It is anticipated that only the county road (FAS 419) and the U.S. Forest Service access road (FS 846) would remain in place. All roads constructed within the proposed permit area as part of the mining operation would be removed unless they are requested to remain in place by the subsequent landowner or lessee. Removal of the roads would entail ripping (if necessary), grading to prevent erosion, topsoiling, and revegetation. The revegetation seed mix would be the same as for the other reclamation areas (table IV-4).

7) Air pollution control measures

Dust generated during mining operations would be suppressed by implementing appropriate control measures, including revegetation of disturbed areas, paving of major roads, and enclosing the crushing and truck-loading facility.

8) Monitoring programs

Monitoring of the mine area by Anaconda personnel would include monitoring of surface reclamation and monitoring of the percolation ponds during and after the operational life of the mine.

During operation, visual inspections would be made to assess whether any erosion or similar environmental problems were occurring. Inspections would also be made of the percolation pond system. Should any problems become apparent, the company would seek the advice of DSL and take the appropriate mitigating actions.

During reclamation, Anaconda personnel would monitor surface conditions to detect any erosion problems. If erosion were to become a significant problem, proper mitigating measures would be implemented by the company.

Monitoring of the water in the percolation ponds would occur only if a surface discharge were to occur. Parameters that must be evaluated and the times of evaluation are specified in Anaconda's MPDES permit. The parameters would include any potential pollutant that may adversely affect the human use or the integrity of the biological community of the receiving water--in this case the Stillwater River.

Ground water conditions at the minesite would be monitored biannually for a period of time required by the Department of Health and Environmental Sciences, Water Quality Bureau, by use of two observation wells located downgradient from the percolation ponds. The monitoring would assess any changes to the quality of the alluvial ground water of the Stillwater River.

b. Mill/tailing-pond reclamation

1) Mill area

The postreclamation land use of the mill area would be predominantly for agriculture (grazing) and wildlife habitat. As with the mine area, the company plans to remove all buildings and other structures during final reclamation. Salvageable materials would be hauled away, while nonsalvageable items would be buried or covered at the site (likely in the tailing disposal area) or disposed of at an approved disposal site. Should any toxic wastes occur, they would be properly packaged, hauled away, and disposed of at an approved disposal site.

2) Tailing area

Proposed postreclamation land uses are wildlife habitat and grazing. The only structure at the tailing area would be a small pump house, which would be decommissioned in the same manner as previously described for other areas.

3) Recontouring

The mill and tailing area would be regraded after operations cease to provide proper surface drainage. As previously mentioned, 364,000 cubic yards of waste rock would be hauled from the mine to the tailing area and would be spread to an average depth of 2 feet. It is expected that the majority of the spreading would have to be accomplished in the winter when the tailing is frozen and capable of supporting equipment. The waste rock would be used to cap the fine tailing impounded in the tailing pond so that equipment can be driven on it. The stability provided by the rock would allow the topsoil to be spread during summer months. The entire capping process may take 6 months to 1 year.

4) Topsoiling and revegetation

For the mill/tailing area, the company proposes to salvage the soil to ensure that at least 18 inches would be available for replacement over the entire disturbed area. (See chapter IV, Soils.) The mill and tailing area would be stripped and the soil material stockpiled. Stockpile stabilization would be the same as at the minesite.

During final reclamation the stockpiled material would be evenly spread over all disturbed areas. It is anticipated that the mill area would be reclaimed first and reclamation of the tailing impoundment would follow. Since the impoundment dams would be expanded throughout the operational life, the company proposes to respread soil and revegetate these structures during the final reclamation phase. Soil would be spread evenly over the waste rock once stabilization of the waste rock cap is complete.

Revegetation methods, seed mixes, and soil amendments would be as described for the mine area.

As with the mine area, the reclamation plan proposed by the company for the mill/tailing area states that the final vegetation establishment would be of comparable cover density to that of similar surrounding areas.

5) Surface and ground water drainage

The surface of the tailing impoundment would be reshaped into a gently dome so that runoff is not impounded. It is anticipated that the impoundment would act as a type of modified drainage divide for the water coming off the area above the impoundment. The shape of this reclaimed area would allow the water on the southern half to move in a

northwesterly and southeasterly direction; the northern half of the impoundment would drain radially to the northwest, north, and northeast.

6) Air pollution control measures

During operation, the company proposes to control fugitive dust and blowing tailing in the same manner as the minesite. Successful revegetation would preclude any significant loss of soil to the atmosphere and the waste rock cap on the tailing area would prevent loss of tailing material. Process dust from milling activities would be 98 percent controlled by the use of four dynamic gas scrubbers, which would be constructed at various locations within the milling complex.

7) Monitoring

Monitoring for the mill/tailing area would fall into two categories: monitoring of surface reclamation and monitoring of the ground water conditions at the tailing impoundment.

Monitoring of surface reclamation by company personnel would be as described for the mine area. In addition, the company would inspect the tailing impoundment periodically until revegetation is deemed successful and the bond has been released. Periodic inspections evaluating erosion and reclamation success would be conducted by the Department of State Lands.

The company would establish reclamation test plots at the tailing area. These test plots would be made after the project has been in operation long enough to produce an adequate amount of representative tailing and waste rock material. The purpose of these plots would be to test waste rock capping and soil replacement techniques for long-term stability and to determine the relative success of revegetation techniques.

The company is proposing a monitor well network of 12 wells located north and east of the impoundment in the Hertzler Valley. All water monitoring would be performed in agreement with applicable Department of Health and Environmental Sciences requirements. All wells would be sampled every three months for the first two years of operation and semiannually thereafter. If levels of the parameters indicate a potential problem, the company would contact the appropriate State agencies and a mitigation plan would be developed.

The constituents listed below would be measured. Only those that appear to be a potential problem would continue to be measured beyond two years. Past this time the company proposes not to monitor those constituents that are not detectable or that exist in insignificant concentrations.

Total Dissolved Solids (TDS)
Total Alkalinity (as $CaCO_3$)
Iron (Fe--total)
Chloride (Cl)
pH (lab)
Temperature (field)
Bicarbonate (HCO_3)
Calcium (Ca)
Zinc (Zn)
Sodium (Na)
Platinum (Pt)
Magnesium (Mg)
Nitrate (as N)
Fluoride (F)
Sulfate (SO_4)
Palladium (PD)
Vanadium (V)
Electrical Conductivity (field)
Chromium (Cr)
pH (field)
Temperature (lab)

The Department of State Lands would also require the measurement of copper and nickel levels.

CHAPTER II

ALTERNATIVES TO THE PROPOSED ACTION

A variety of alternatives to the proposed action were considered. These included alternative adit locations, tailing pond sites, mill sites, mine-mill-tailing pond arrangements, mining methods, and transportation methods. Upon analysis, these alternatives either proved to be inferior to the proposed action or without overall environmental advantage.

Most of the alternatives would affect private land, where Anaconda's activities are regulated primarily by the Department of State Lands. A limited number of alternatives would affect national forest system lands, where Anaconda's surface activities are are regulated primarily by the U.S. Forest Service. The number of alternatives affecting national forest land are limited for four reasons: (1) the national forest system lands affected by Anaconda are open to mineral entry, (2) Forest Service authority is primarily limited to national forest land, (3) only 3 percent of the permit area lies on national forest land, and (4) some mine facilities--the adit, roads, some buildings--are already in place as a result of exploration or previous mining activities.

The following sections evaluate all alternatives considered, both on national forest system and private lands. The specific reasons for the elimination or consideration of alternatives are discussed. Following this is a discussion of, first, alternative sources of platinum and palladium, and second, uncertainties that could change the consequences of the project.

A. SITING ALTERNATIVES

1. Adit Entrances

In early 1979 the U.S. Forest Service studied two possible sites for the location of the main exploration adit that Anaconda Copper Company (now Anaconda Minerals Company) wanted to open up for access to the platinum-palladium ore zone. The two sites, were the only logical access points to the ore body, and both were on national forest land. Each presented about the same level of potential environmental impact; however, the current exploration adit--the Minneapolis adit--was chosen for excavation because it was not readily visible from FAS 419, the county road.

A third alternative, to put the adit site on private land, was also considered. This could have been accomplished with a horizontal tunnel sufficiently deep to avoid disruption of Custer National Forest lands. This would have added several hundred feet of tunnel and would have placed the adit portal within direct view of the public in an area prescribed by the Forest Service for "retention" (maintenance of scenic character). This would also have disrupted a private residence (the Hjelviks residence) because the mine portal would have been located near the house. This alternative was dismissed as unreasonable during

analysis of the exploration plan of operations and is not considered further. (For a complete report on the site analysis, refer to the Forest Service May 10, 1979 Environmental Assessment Report, on file with Custer National Forest.)

In the summer of 1981 the U.S. Forest Service and Department of State Lands prepared an environmental assessment and subsequently approved an Anaconda proposal to drive a second (1,980-meter level) adit on national forest land. The second adit is confined almost exclusively to previously disturbed ground on an existing road. The adit's purpose was to verify surface projections and "establish the attitude of the [mineral] zone near the surface." In the analysis the Forest Service evaluated some possible alternatives to allowing construction of the 1980-level adit; however, the alternatives would not have provided the company the opportunity to get necessary evaluation data and would have resulted in additional development of undisturbed forest land. (For a more complete report, refer to the June 1, 1981, Environmental Assessment Report, on file with Custer National Forest.)

Since the two adits necessary to implement the proposed project are permitted and in place on national forest system lands pursuant to an environmental assessment report (June, 1981), no reason exists to further evaluate alternative adit locations. Likewise, percolation ponds and some other support facilities for the exploration activities were found suitable for mine support by the USFS in the 1979 environmental assessment report of the Minneapolis adit and were subsequently approved for construction.

2. Surface Structures

An alternative to the proposed plan of operations would be to place some or all surface-disturbing structures and facilities on Anaconda lands rather than entirely or partially on national forest systems lands. (See fig. I-4.) The advantages of doing this, although slight, include less of an encumbrance to national forest system lands from buildings and roads, less land surface disturbance on national forest system lands, and as a consequence, lower administrative costs to the Forest Service.

The disadvantages include slightly greater visual impacts as a result of having to move the waste dump closer to the county road (FAS 419) and added costs to the company for having to move existing buildings. Moving the explosive storage away from the mine adit would probably increase safety hazards associated with transport and storage of explosives.

Because this alternative has no significant advantage and would require moving existing structures, it is not considered further, with the following exception: the proposed road accessing the storage bin is located in a position considered to be visually unacceptable by the Forest Service. With relatively level ground on private, Anaconda-controlled land east of the loadout area, there is no reason to create

the cut necessary to place the road in its proposed location. The cut created by the road would be evident from FAS 419 and increase surface disturbance. (See chapter IV, Aesthetics, Mitigating Measures.)

3. Mill/Tailing Sites

Anaconda contracted with Mountain States Mineral Enterprises, Inc. (MSME) to perform a preliminary mill/tailing location study (MSME, 1981). The primary task of this study was to determine the best overall mill and tailing pond sites within the upper Stillwater Valley that would be environmentally, technically, and economically feasible. In addition, the study presented engineering and geological constraints necessary for the design and construction of a mill/tailing complex. The Department of State Lands concur with the study criteria and the results.

The study identified alternative mill and tailing sites and ranked them according to overall suitability. An alternative with the mine but without a mill and tailing pond was not considered, because the expense of transporting the ore to an existing processing facility would have been too expensive.

a. Criteria for evaluation

The study considered only those potential pond areas in the valley that were capable of holding 5 to 15 million tons of tailing and that lay within 5 to 10 miles of the Minneapolis adit; engineering estimates determined that any distance beyond that would have been both labor and time inefficient, and therefore too costly. All lands meeting the above criteria were considered regardless of ownership or control. Eleven potential tailing pond sites and four potential mill sites were identified. (See table II-1 and fig. II-1.) Since the tailing pond would be much larger and present many more siting constraints than the mill site, the selection of a suitable tailing pond site was considered the primary objective. That is, the location of the tailing pond would determine the location of the mill. Ranking of the tailing pond locations was based on the following environmental and engineering considerations:

1) Geology/Soils: geologic structure, slope stability, available construction materials, and foundation conditions.
2) Hydrology: proximity to flood plain, drainage basin area, and proximity to ground water.
3) Engineering, Design, and Construction: seepage control potential, storm diversion control, impoundment expansion potential, erosion potential, land form alteration, additional land requirements, and capital cost.
4) Mill/Pond Operation: proximity of site to mine, water recycling potential, operating costs, and production limitations.

5) Abandonment Criteria: reclamation potential, post-operational pond maintenance, and abandonment costs.
6) Environmental Effects: air resources, wildlife (critical habitats, human disturbance, diversity of habitat), vegetation (diversity, threatened or endangered species), aquatic ecology, soils, recreation, transportation, aesthetics, land use, cultural resources, and permit requirements.

b. Site evaluations

Appendix 1 gives the results of the tailing pond site evaluation based on the above categories. The MSME analysis concludes that only four of the eleven tailing pond sites warranted further study. The other seven were eliminated due to the number of major impacts that would have occurred if they were used. The four sites, in order of decreasing desirability, were B--Hertzler Ranch I; C--Hertzler Ranch II; G--Stratton Ranch; and D--Hertzler Ranch III.

The most desirable site identified by MSME was site B, Hertzler Ranch I and was included as the proposed pond site in the permit application. This site was considered superior to all others for

TABLE II-1--Tailing Pond and Mill Sites Considered[1]

Tailings Pond Sites	
A--Robinson Draw	G--Stratton Ranch
B--Hertzler Ranch I	H--Limestone Cove
C--Hertzler Ranch II	I--Old Tailings Area
D--Hertzler Ranch III	J--Mine Site
E--Stanley Coulee	K--Beartooth Ranch
F--Prairie Creek	

Mill Sites

1--Northern Valley Site 1--servicing A, D, and E above
2--Northern Valley Site 2--servicing B and C above
3--Mine Site--servicing G, H, I, J, and K, above
4--Prairie Creek--servicing F above

[1] See Figure II-1 for locations of these sites.

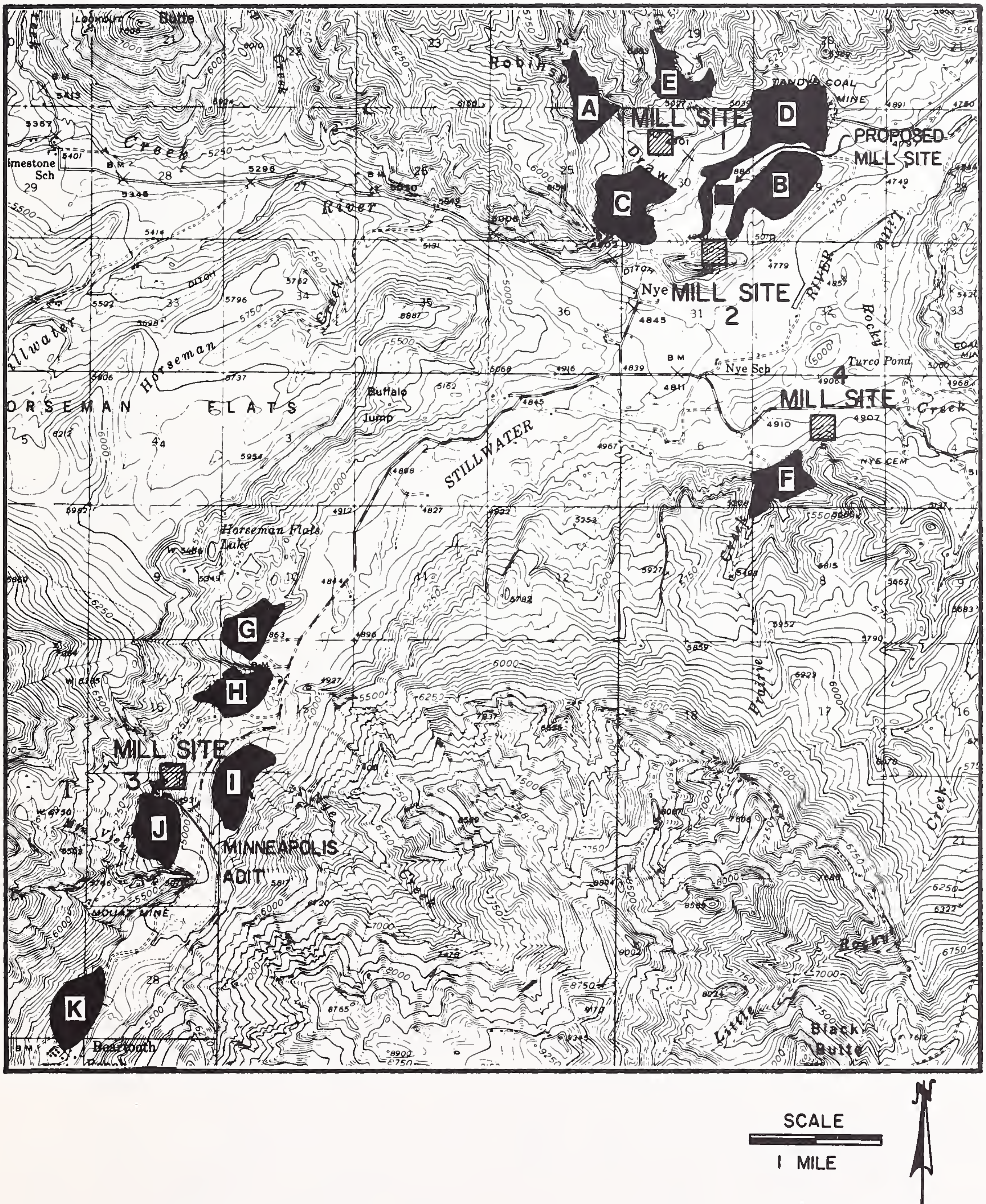


FIGURE II-1--Alternative Mill and Tailing Pond Sites

environmental as well as economic reasons. Site B's estimated construction costs would be lowest. Despite this site being the most favorable site environmentally, several moderate impacts would occur if it were to be used. Factors rated by MSME as "moderate" included erosion potential, operating cost, production limitations, airborne particulates if tailing are dry, critical wildlife habitat, soil production potential, and recreation. Factors rated as "severe" for this site were the proximity of mill/tailing pond to mine and road traffic impacts. Nonetheless, this site best fit the list of criteria by which all sites were judged.

As shown in appendix 1, the remaining three sites of the top four had a much greater number of factors rated "moderate" and "severe" than the chosen site. Therefore, none of these will be considered further in this EIS.

With the location of the tailing pond (the deciding factor) selected, selection of a matching mill site remained. Mill site 2 (table II-1) was found to be the most desirable; however, because of land acquisition problems, Anaconda actually selected a site about 2,000 feet (610 meters) north of mill site 2 (fig. II-1). This minor change in mill site location would not significantly change the analysis given in the study for site 2. Site 2 (and the proposed site) was found to have the following advantages: (1) protected from view of FAS 419 travelers and (2) low operating costs because the tailing flow would be by gravity feed. Disadvantages included (1) high capital costs because of the length of road needed to provide access from the existing dirt road and (2) high operating transportation costs because of the distance from the mine.

The other alternative mill site that could have serviced pond site B was mill site 1. This site would have had similar advantages and disadvantages to the proposed site with the added disadvantage of higher operating costs from (1) higher truck haulage requirements, both inbound and outbound, and (2) pumping tailing to the pond site. Because of these shortcomings, mill site 1 was eliminated from further consideration and will not be discussed further.

B. TECHNOLOGICAL ALTERNATIVES

1. Tailing Backfill into Mine: Cut-and-Fill Stopes

Anaconda has proposed mining the platinum-group metals by using shrinkage stopes. (See chapter I.) Another technically feasible way of mining this particular ore body would be to use cut-and-fill stopes. Whereas shrinkage stoping leaves a hollow cavity after mining, cut-and-fill stoping refills the cavity with mill tailing from processed ore. To use cut-and-fill stoping, Anaconda would probably have to locate the mill adjacent to the mine adit, so that tailing could be put back into the hollowed portions of the ore zone.

The primary reason for using cut-and-fill stopes is for support: filling the stope with tailing can give the wall rock necessary support where the wall of the surrounding mined-out cavity would be unstable and could collapse. In the case of the Anaconda Stillwater Project, this is unnecessary. The Stillwater Complex (the mineralized platinum-group zones and the surrounding bedrock) are strong enough that large blocks of the ore can be mined without risking structural failure.

A second reason to use cut-and-fill stopes is to reduce the waste to ore rock ratio by selectively mining the ore zone. With cut-and-fill stopes, miners can work around and leave small, low-grade zones. Although a large block of low-grade ore also could be left while using shrinkage stopes, small pockets of low grade material cannot. They must be extracted. In the case of the Stillwater Complex, small low grade zones would be very difficult to identify. The use of cut-and-fill stopes to selectively mine on a small scale would therefore be of little advantage.

The third reason to use cut-and-fill stopes would be to return waste material coming out of the mill to the mine. This would eliminate the need for a tailing pond. This is a major environmental advantage of the cut-and-fill method in the Anaconda Stillwater Project, but one that would add substantially to Anaconda's operational costs. Removal of the ore rock would be more complicated and labor intensive than shrinkage stoping and would present complicated logistical problems. It would require that mill tailing be pumped via an elaborate piping system back into the mine workings and then be scraped back into the mined-out ore zone.

Cut-and-fill stoping offers no distinct advantages and could significantly increase Anaconda's operating costs. Further, the proposed tailing pond poses no significant environmental problems (chapter IV). As a result, the alternative of using cut-and-fill stopes was discussed and is not considered further in this EIS.

2. Mill Located Near Adit With Slurry Pipeline to the Hertzler Valley Tailing Pond

Anaconda has proposed trucking ore rock to a mill and tailing pond complex in the Hertzler Valley. Another technically feasible mine configuration would be to construct the mill near the Minneapolis adit and slurry the tailing in a pipeline to the Hertzler Valley tailing pond. A slurry line, however, would have a number of disadvantages.

First, if built, the slurry line would run parallel to the Stillwater River for about 5 miles, which would create a potential environmental hazard should it break. A slurry line would also require a small amount of additional land for a right-of-way; the acquisition of numerous landowner easements could be a major problem.

In addition, the day-to-day logistical problems associated with the operation of a slurry line are much greater than those of truck haulage:

(1) there is a much greater risk of a significant interruption because of the critical nature of the slurry line to the entire operation--if the slurry line goes out of service, the mill and eventually the entire mine would have to shut down; (2) the slurry line would demand far more vigilance on the company's part to insure that the tailing could not spill into the river; the heightened level of monitoring necessary would increase the cost of operations.

Further, if Anaconda were forced to locate the mill near the Minneapolis adit, Anaconda would probably choose to move the tailing pond to a site closer to the adit. (See fig. II-1.) Possible tailing pond sites that are closer have several problems that make them less practical and environmentally feasible than the site chosen by Anaconda.

One advantage of the slurry line is that it would reduce the increase in vehicle traffic on FAS 419 and so reduce the number of potential accidents. This, however, would not be significant. The haul truck traffic would be removed from the public highway, but the number of work trips by commuting mine workers on the segment of FAS 419 between Nye Junction and the mine would increase by about 36 trips per day. Traffic volume attributable to the slurry line would thus only be about 23 percent less than the proposed use of truck haulage. In addition, the segment of FAS 419 proposed to be used for hauling has a much lower accident rate than the rest of FAS 419. All of the traffic volume increases between Absarokee and Nye--where the accident rate is highest--would still occur.

Another advantage of the slurry line is that it would reduce the number of wildlife roadkills.

Because the disadvantages outweigh the advantages, the slurry line alternative was considered unreasonable and so is not considered further.

3. Ore Processing Methods

Anaconda has proposed using a flotation millings process to extract the sulfide and precious metals from the ore rock. The process is an effective method for recovery of most sulfide ores, generally yielding over a 90 percent recovery rate.

Other methods of concentrating the platinum-group metal ore from the Stillwater Complex are available; however, all are more costly and most would not work as well as the process Anaconda proposes to use. For example, Anaconda could use some form of gravity separation, but recovery of sulfides and precious metals would be reduced. Anaconda could also use chemical extraction, but this would be more expensive and environmentally detrimental. The caustic chemicals that would be emptied into the tailing pond would make reclamation more difficult and could lower water quality of the Hertzler Valley.

Because of their significant shortcomings, milling process alternatives other than the one proposed by Anaconda were dismissed as unreasonable and will not be discussed further.

4. Other Mining Methods

Only two general mining methods exist by which the platinum-group metals in the Stillwater Complex can be feasibly mined: shrinkage stoping and cut-and-fill stoping. A third method, called sublevel long-hole stoping, was initially evaluated by Anaconda but considered unviable. (For a general description of sublevel long-hole stoping, see Stout, 1980.)

The major advantage of sublevel stoping is that it is a safer method than shrinkage stoping. In sublevel stoping, the miners work in tunnels, whereas in shrinkage stoping the miners constantly work under a ceiling of freshly broken rock, from which undetected loose pieces can sometimes drop. In addition, during ore withdrawal in the shrinkage stoping method, passageways can become clogged and later unexpectedly collapse, endangering miners below (Koehler Stout, Montana College of Mineral Science and Technology, oral commun., April 21, 1982).

The reason sublevel stoping was deemed unviable is that it requires the caving of ore in slabs. The platinum-group-metals mineralized zone that Anaconda proposes to mine, however, is thin and variable. If the ore were caved in slabs, the company would obtain considerable lower grade ore along with the desirable ore. This would make the project uneconomic (Jim Harrower, Anaconda Minerals Company, oral commun., April 15, 1981) The alternative of sublevel long-hole stoping was thus ruled unreasonable and is not considered further.

Other mining methods, such as open pit mining, would be so costly or unworkable that they were also considered unreasonable and are not discussed further.

C. TRANSPORTATION

1. Ore Conveying System

An alternative to transporting ore from the mine to the mill in trucks would be to use a conveying system. This has two disadvantages over the proposed operation.

First, a conveying system would require the acquisition of additional private land for a right-of-way. Further, a conveying system would probably not be economically feasible. Although the operating cost of a conveying system would be somewhat lower per ton-mile than truck haulage, the initial capital cost would be much higher (Jim Harrower, Anaconda Minerals Company; written commun., January 26, 1982). A conveying system between the mine and the mill has been estimated to initially cost more than $10.3 million, not including right-of-way acquisition.

The system has at least one advantage: it would reduce the accident potential on FAS 419; however, the reduction would not be significant, for the same reasons given in the discussion of the slurry line. The conveyor would also reduce the number of wildlife roadkills.

Because a conveying system would do little to reduce the impacts of ore transport and because the system would be extremely costly, the alternative was not considered reasonable and will not be discussed further.

2. Haul Road

Another alternative to the proposed transportation plans would be to build a separate road for truck haulage of Anaconda's ore. This alternative, like the slurry line and conveyor, has a number of disadvantages over the proposed operation.

First, a haul road would require the acquisition of additional private land for a right-of-way--approximately 18 acres, assuming a 24-foot-wide, 6.3-mile-long right-of-way would be necessary. In addition, the area between the new haul road and the existing highway would probably not be available for other uses. Further, because the same amount of traffic would be generated, no improvements in the inconvenience experienced by area ranchers moving livestock along or across FAS 419 would be expected. In addition, a parallel haul road would adversely affect the scenic quality of the Stillwater River Valley.

The main advantage of using a parallel haul road would be the resulting reduction of the accident potential on FAS 419. Again, however, the reduction would not be significant, for the same reasons given in the discussion of the slurry line. An additional advantage would be that the new haul road could be located away from the historical peregrine falcon nesting site.

A haul road dedicated to mine truck traffic would therefore not be a reasonable alternative, and it is not considered further.

D. ALTERNATIVE METHODS OF SATISFYING THE NEED FOR PLATINUM AND PALLADIUM

The current sources of most of the world's platinum group metals are South Africa, the U.S.S.R., and Canada. (See chapter I.) Reserves in these countries are more than adequate to meet forecasted world demand over the next 25 years and beyond (Bleistein, 1978, p. 12). The U.S. can thus continue to fulfill its platinum and palladium demand by buying these rare metals from abroad, rather than mining them within the country. One disadvantage of this is that foreign political instability could interrupt supply; however, Congress is considering the stockpiling of strategic metals. A sufficiently large stockpile obtained from foreign sources would assure the strategic safety of the U.S. without requiring the development of the Stillwater Complex.

E. UNCERTAINTIES THAT COULD CHANGE CONSEQUENCES

Two uncertainties in particular that could change the projected consequences discussed in chapter IV are discussed below.

1. Duration of Mine

The duration of mining by Anaconda Minerals Company would depend on three independent factors: (1) the amount of mineral reserves, (2) the rate of ore production, and (3) the price of the minerals extracted.

a. Mineral Reserves

The amount of mineral reserves Anaconda will ultimately control has yet to be determined. Anaconda plans additional drilling to further delineate the mineralized zone. By late fall 1982 Anaconda plans to have finished this drilling exploration program (Jim Harrower, Anaconda Minerals Company, oral commun., February 1982). Not until the data from this program is evaluated will Anaconda know how large its mineral reserves actually are.

It is Anaconda's intention to establish with reasonable certainty before opening the mine that roughly 20-years worth of ore can be produced at a rate of up to 1,200 tons per day. If Anaconda were to open the mine, known reserves could then change, as estimates of the extent of the ore body are refined. Significantly less reserves would force the early closure of the mine. Significantly greater reserves (e.g. by mining deeper or acquiring additional reserves from some other claim holder in the area) could add to the life of the mine. The price of the metals produced would in part determine the amount of mineralized rock considered reserves.

b. Ore production

Anaconda could produce ore at different rates. The company has chosen a maximum mining rate of about 1,200 tons per day. Considering the size of the mineral base and the logistics of mining, Anaconda cannot operate at a significantly higher production rate without substantially increasing costs (Jim Harrower, Anaconda Minerals Company, oral commun., February, 1982), although the mill facilities would be able to handle up to 1,400 tons per day.

Anaconda probably would not produce ore at a significantly lower rate, because fixed and operational costs would not decrease substantially with drops in production. For instance, a lowering of the production rate would not be matched by a proportional drop in the number of employees. A production rate of roughly 1,000 to 1,200 tons per day is thought to be the optimum level for this mine (Jim Harrower, Anaconda Minerals Company, oral commun., February, 1982).

c. Prices of platinum and palladium

Price projections, along with estimates of the reserves, would determine whether Anaconda would develop the mine. The price of the metals produced would also determine how long the mine would stay open. If the prices of the metals were to fall and hold below the level needed for profitability, the mine could close early. If the price of the metal were to gain faster than Anaconda projects, the mine life could be extended. Variables such as drastic increase in demand for cars by Americans could increase the price commanded by producers of platinum and palladium metal. Changes in technology could lower demand. An interruption in platinum-group metal supplies could also affect the price and change the life expectancy of the mine. Such possibilities cannot be predicted.

d. The effects of a shorter or longer mine life

A major change in the life of the mine would change the consequences of the proposed action presented in chapter IV. A significant reduction in the life of the mine would mean that social impacts caused by the loss in jobs would occur sooner than projected. Stillwater County and the State would receive less revenue. Adverse impacts on wildlife would be reduced once the mine closed. An early closing of the mine would also mean less tailing would be placed in the tailing pond and earlier reclamation of the mine and mill site would occur. The increase in particulate concentrations caused by haul trucks would be eliminated.

If the mine life were increased considerably--an unlikely possibility given Anaconda's limited mineral ownership--some projected impacts would be prolonged. Truck traffic would continue, as would the increased risk of accidents to travelers of FAS 419 from Absarokee to the minesite. Anaconda employees and merchants in the area and the county would receive the benefits of an increase in mine life in the form of job security and income. Particulate concentrations caused by trucks would remain higher than premining conditions. Impacts caused by the project that would affect bighorn sheep and other wildlife would continue. The tailing pond would increase in size, although extra capacity is available. Reclamation of the mine, mill, and tailing pond sites would be delayed.

2. Cumulative Development of other Mineral Resources

The two major nonplatinum group-metal resources of importance in the Stillwater Valley are chromite and nickel-copper. Development of chromite during the 20-year life of Anaconda's operations is very unlikely. Some possibility exists that a nickel-copper mine could be developed after 1990 (Bleistein, 1978, p. 9). But neither resources would probably be mined unless major economic, political, and or technological changes were to occur.

Chromite ore has been mined previously by underground methods along Mountain View Creek about a mile from Anaconda's Minneapolis adit. (See chapter III, Geology.) The environmental impacts of renewed mining in the area would be less than mining an undisturbed area of the Stillwater Complex. Cumulative impacts on wildlife and social and economic conditions would be most significant.

Because chromite development during the 20-year life of Anaconda's operation is unlikely, specific projections are not included here. Any additional mining would have to be permitted by the Department of State Lands and, if it occurred on national forest system lands, by the Forest Service. If a mine application were submitted, a detailed cumulative impact assessment would then be conducted.

A nickel-copper mineralization zone is also located in the general area of Anaconda's Minneapolis adit. This zone is not now economic to mine and may remain uneconomic for some time. The world price of nickel and copper is now very low and an improvement in the price is not immediately expected.

If the nickel-copper zone were to be mined, open-pit mining methods would probably be used, and surface disruption would be considerably greater than in mining platinum-group metals. For a mine to be reasonably profitable at the low ore grades found in this area, the production rate would have to be high. Larger tailing ponds than the one proposed by Anaconda would probably be needed. The physical, social, and economic impacts of open-pit mining of the nickel-copper zone would be far greater than those projected for Anaconda's platinum-palladium project.

CHAPTER III

DESCRIPTION OF AFFECTED ENVIRONMENT

During the scoping process carried out for this EIS, the public raised a number of concerns over the Anaconda Stillwater Project. These concerns, combined with those of the U.S. Forest Service and the Department of State Lands, guided the selection of topics to be covered in this document. (The concerns are listed in the introduction in table IN-1.) This chapter covers each topic selected, presenting the current condition of the social, economic, and natural environments that may be affected by the project and the condition these environments would be in if the proposed project did not take place. Chapter IV goes on to discuss the impacts the proposed project, covering each concern raised during the scoping process.

A. GEOLOGY

1. General Geology--Stillwater Complex

The platinum-group metals that Anaconda Minerals Company is considering mining are part of the Stillwater Complex. (See fig. III-1.) The complex is from 1 to 5 miles wide and 28 miles long, crossing the Boulder and Stillwater River Valleys. The complex originated as a magma intrusion. The original intrusion contained iron, nickel, copper and platinum-group metals which settled out at different levels as the molten mass crystalized deep within the earth. Mountain building forces that created the Rocky Mountains brought a large block of this intrustion (the Stillwater Complex) to the surface. This type of deep intrusion exposed at the surface of the earth is rare. Because of its unusual geologic character and because of the metal associated with it, the Stillwater complex has been investigated by numerous researchers (Howland, Peoples and Sampson, 1936; Winmler 1948; Jones, Peoples and Howland, 1960; Jackson, 1968; page 1977; Raedeke, 1979; Conn, 1979).

Platinum-group metals occur in several layers of the Stillwater Complex. The layer of highest concentration is only 3 to 6 feet wide. This narrow zone is nearly continuous and appears to extend the entire length of the complex. (See fig. III-1.) Nickel-copper and chromite deposits are also present throughout the complex, but are less continuous, occurring as scattered, isolated patches.

The Stillwater Complex is the largest concentration of platinum-group elements known to exist in the United States; it contains an estimated 70 percent of domestic reserves (Dunnet, 1977). The National Academy of Sciences estimated that the Stillwater Complex holds more than 125 million troy ounces of platinum-group metals--roughly 70 years of reserves at current consumption rates. If the Academy's estimates are correct, the Stillwater Complex could be a major U.S. supplier of platinum-group metals in the future.

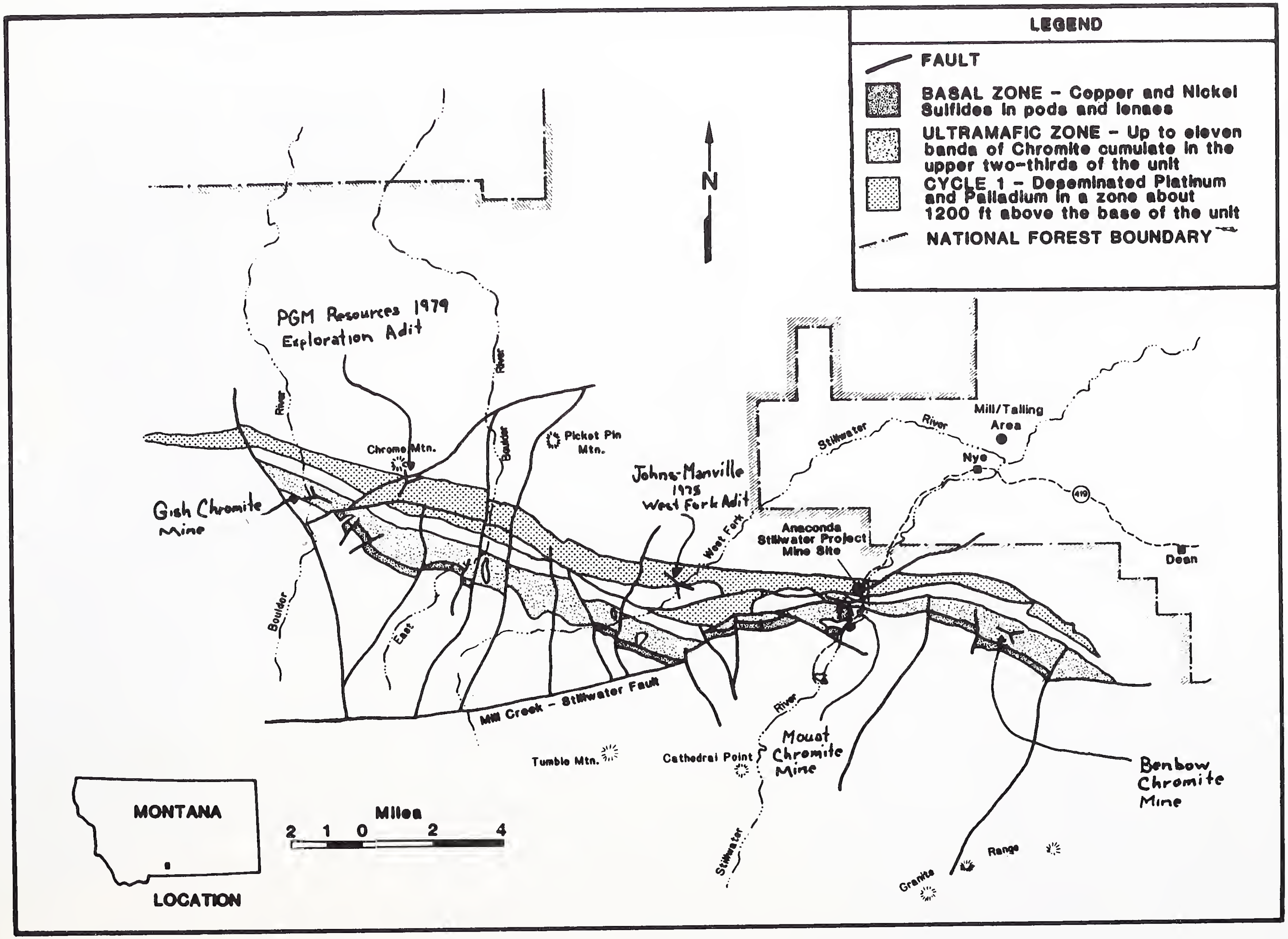


FIGURE III-1--Generalized Geologic Map of the Stillwater Complex

2. Historical Mining and Mineral Interest in the Stillwater Complex

a. Chromite

Interest in ore within the Stillwater Complex first developed during World War I, but it wasn't until World War II that ore was actually produced. In 1941 Anaconda Copper Company received a subsidized contract with the U.S. Government and began underground development at three separate sites along the Stillwater Complex: (1) the Benbow area; (2) the Mountain View area, 6 miles southwest of Nye; and (3) the Gish area. (See fig. III-1.) The Anaconda Company produced about 71,500 long tons of concentrate from the Benbow area averaging about 42 percent chromite and 26,000 tons of concentrate (averaging about 34 percent chromite) from the Mouat Mine. All operations stopped in 1943 because high-grade chromite was again available from overseas sources (Read, 1977).

From 1953 to 1961 the American Chrome Company, under another U.S. Government subsidized contract, produced 900,000 tons of chromite concentrate from the Mouat Mine. Some of this was stockpiled near Anaconda's present mine headquarters building for strategic purposes. In the early 1970s the U.S. government sold the chromite stockpile to a private company. They have gradually been removing it, and less than half of the original stockpile now remains.

An estimated 70 percent of domestic reserves of chromite ore remain in the Stillwater Complex. All of this ore is a high-iron low-chromium variety, only marginally suitable for stainless steel production. Further advances in chromium-ferro alloying could make these deposits economic (Read, 1977, p. 12).

b. Copper and nickel

As early as 1936 the Stillwater Complex was recognized as a possible source of other metals besides chromite, including copper, nickel and platinum-group metals. As yet, none of these metals have been produced in commercial quantities. The copper-nickel deposits are important mainly because of their nickel content, but the nickel concentrations are not high enough to justify their development at current prices. The copper concentrations are well below economically mineable limits, because higher grade ore is available elsewhere.

Three companies own the largest blocks of copper-nickel deposits within the complex. They are the Anaconda Minerals Company, AMAX, and Cyprus Mines. Individuals and the Monta Vista Corporation of Billings own smaller portions.

c. Platinum-group metals

When the demand for and price of platinum-group metals drastically increased in the late 1960s and early 1970s, exploration for these

metals began in the Stillwater Complex. Johns-Manville Sales Corporation, which initiated exploration work in the Stillwater Complex in 1967 identified four zones with high platinum-group metal values. One of these was found to be nearly continuous for about 24 miles of the 28-mile-long Stillwater Complex. As a result the company filed claims on a large portion of the complex. (See fig. III-2.)

Johns-Manville initiated underground exploration in the north wall (6,500 foot elevation) of the West Fork of the Stillwater River. (See fig. III-2.) The ore grades encountered, averaging 14.7 parts per million of platinum, were up to 2 to 4 times those typical of the Merensky Reef in the Bushveld complex of South Africa, the major world supplier of platinum-group metals. Nonetheless, Johns-Manville had to abandon this operation in 1976 because water under very high pressure was encountered in the adit.

In 1979 Johns-Manville, in partnership with Chevron USA, began development of a second exploration (Frog Pond) adit further west in the Stillwater Complex. (See fig. III-2.) Exploration work and project engineering assessment for this project are continuing.

Anaconda owned the mineral rights to the area around the old Mouat Chromite Mine. In 1977 Anaconda mapped its properties, identifiying a zone of platinum-palladium mineralization on its existing mineral claims. In mid-1979 the company began construction of the Minneapolis adit and by late December reached the mineralized zone. (See chapter I.)

3. Anaconda Study Area

The Anaconda geology study area covered most of the Stillwater River Valley from the minesite to the proposed mill and tailing pond site.

a. Minesite

1) Topography and geomorphology

The Minneapolis adit is located one-quarter mile west of the Stillwater River with steep mountains surrounding it on the west and east. (See fig. III-3.) The topography climbs at less than a 10 percent grade from the river up to the Minneapolis adit, then quickly steepens to a grade of about 25 percent. Further upslope, within one half mile of the river, the landscape again flattens, to less than 8 percent. Here, Mountain View Lake lies in a depression cut into the mountain by a former glacier. Several small streams near the mine area flow off the steep mountainside, emptying into the Stillwater River. Mountain View Creek flows from Mountain View Lake, emptying into the Stillwater River along the southern boundary of the minesite. (See fig. III-3.)

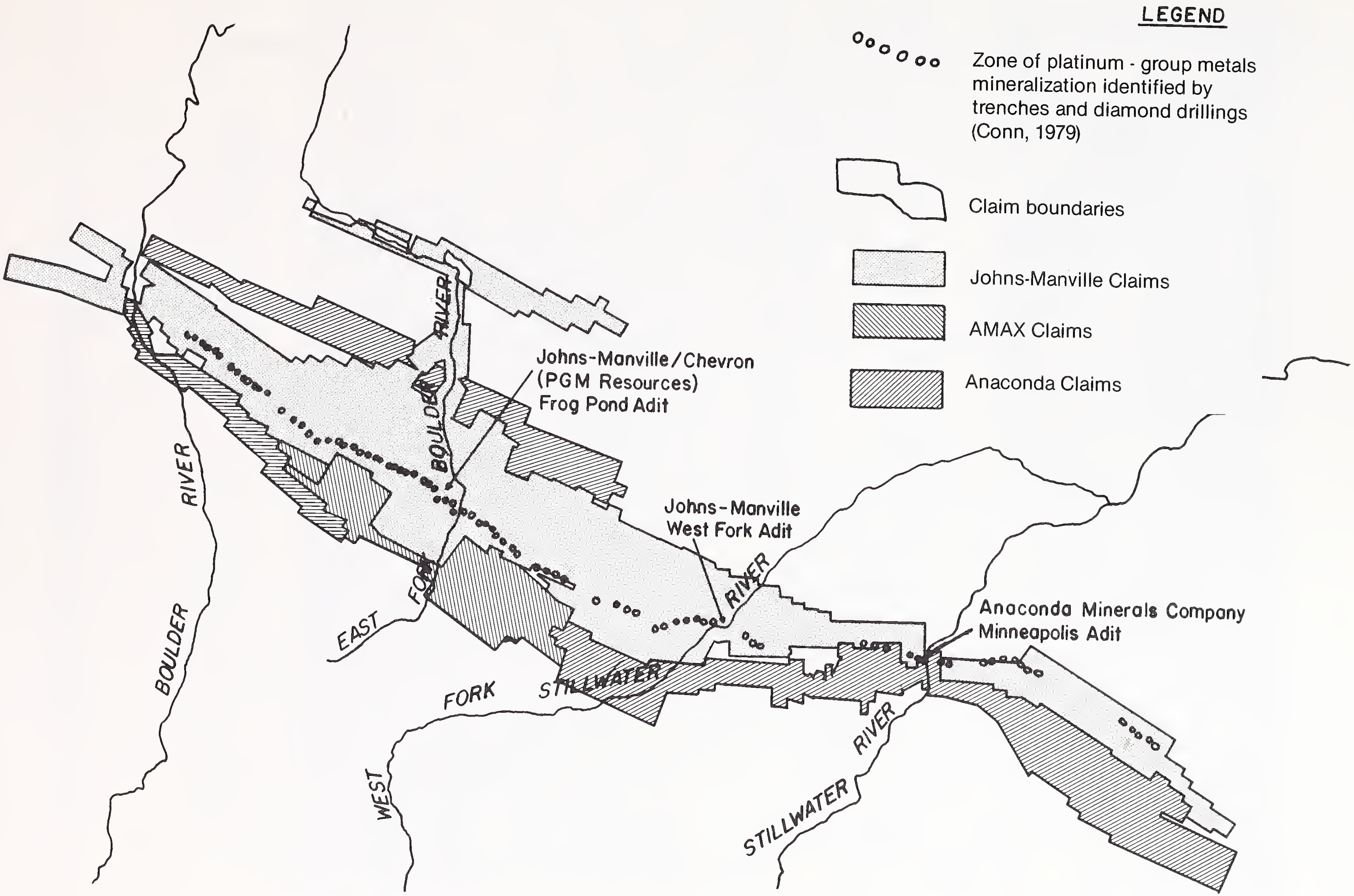


FIGURE III-2--Mineral Ownership of the Stillwater Complex

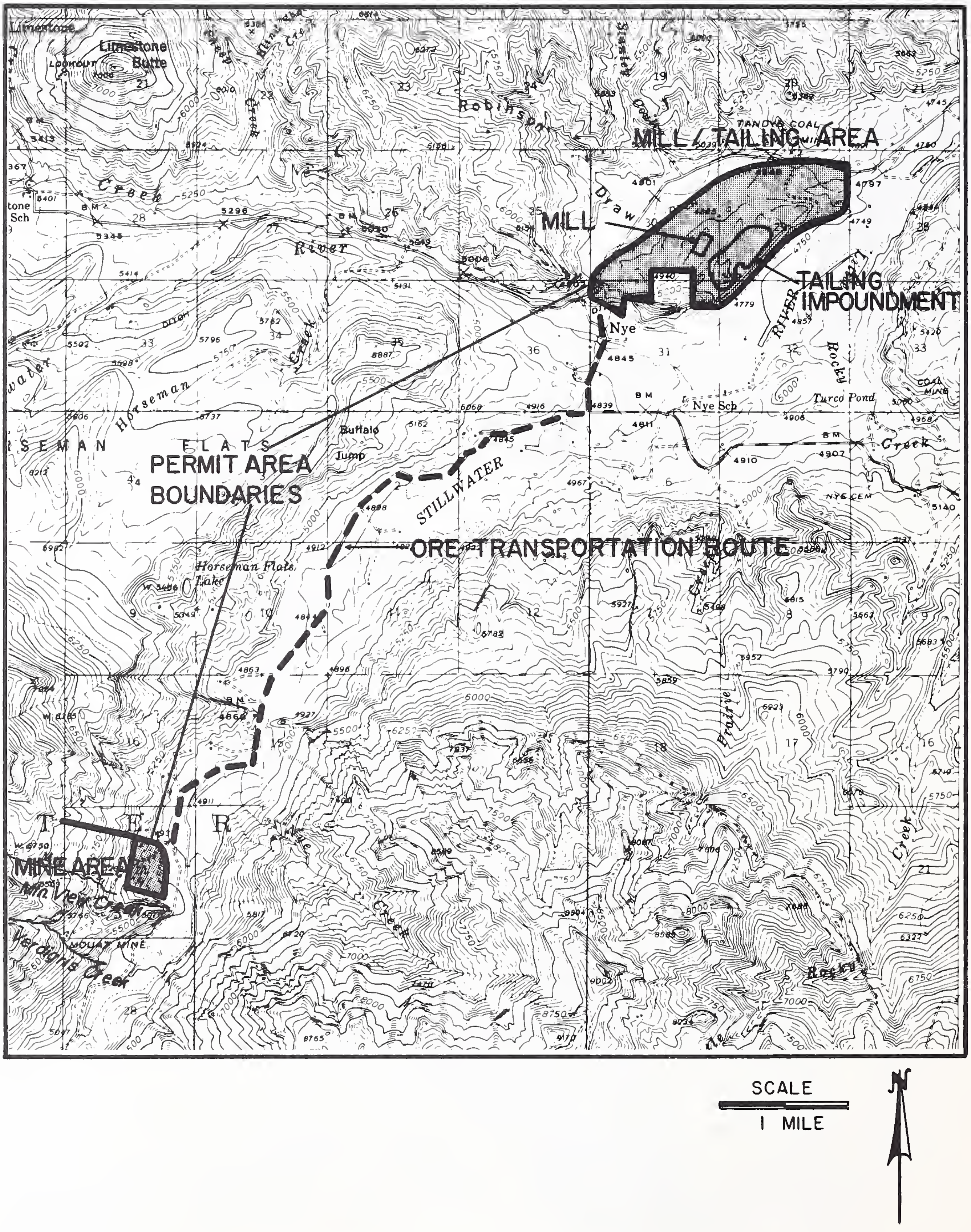


FIGURE III-3--Topography of the Permit Area

2) Surficial geology

Under the headquarters buildings and the adit lie alluvial (stream-laid) sediments deposited on top of both landslide deposits and bedrock. Two large landslides cover much of the slope above the mine headquarters and the Minneapolis adit. (See fig. III-4.) These slides probably occurred over 10,000 years ago, during one of several glacial advances that occured in North America. A portion of the toe of the major slide has been removed by glaciers or the river, but landslide material was encountered in wells drilled into the alluvium of the Stillwater River downslope of the minesite. (See Geologic Hazards.)

3) Bedrock geology

The Stillwater Complex cuts across the Stillwater River Valley at nearly a right angle. (See fig. III-1.) The complex extends east into Nye Basin and continues west from Anaconda's mine for about 25 miles into the Boulder River Valley. (See fig. III-1.) In the general area of Anaconda's minesite, the rocks of the complex are exposed over a 1.5- to 2-mile-wide band. The layers of the complex dive steeply under the surface to the north at about 50 to 80 degrees (measured down from a horizontal plane).

4) Structural geology

The general area around the mine facilities and mine adit has several large faults that offset the bedrock units. (See fig. III-4.) The east-west trending South Prairie Fault passes just north of the Minneapolis adit. This fault appears to have offset some of the platinum-group mineralized zone that Anaconda proposes to mine and has slightly reduced the amount of ore reserves that the company had anticipated having (Jim Harrower, Anaconda Minerals Company, oral commun., February 1982). The fault is at least 5 miles long.

Two other faults pass through the area immediately outside the mine permit area. Lake Fault lies just south of Anaconda's offices and trends in an east-west direction, possibly extending across the Stillwater River Valley. The Stillwater Valley Fault, probably the biggest fault near the mine area, is not visible because river deposits cover it. Its presence is indicated by offset geologic units on opposite sides of the valley. The length and continuity of this fault is unknown.

Most of the major movement along faults near the minesite occurred during the mountain building processes that formed the Rocky Mountains from 1,450 to 60 million years ago. No faults within or adjacent to the minesite show evidence of recent faulting.

5) Geologic hazards

Geologic hazards are natural conditions that possess the potential to damage property or endanger human safety.

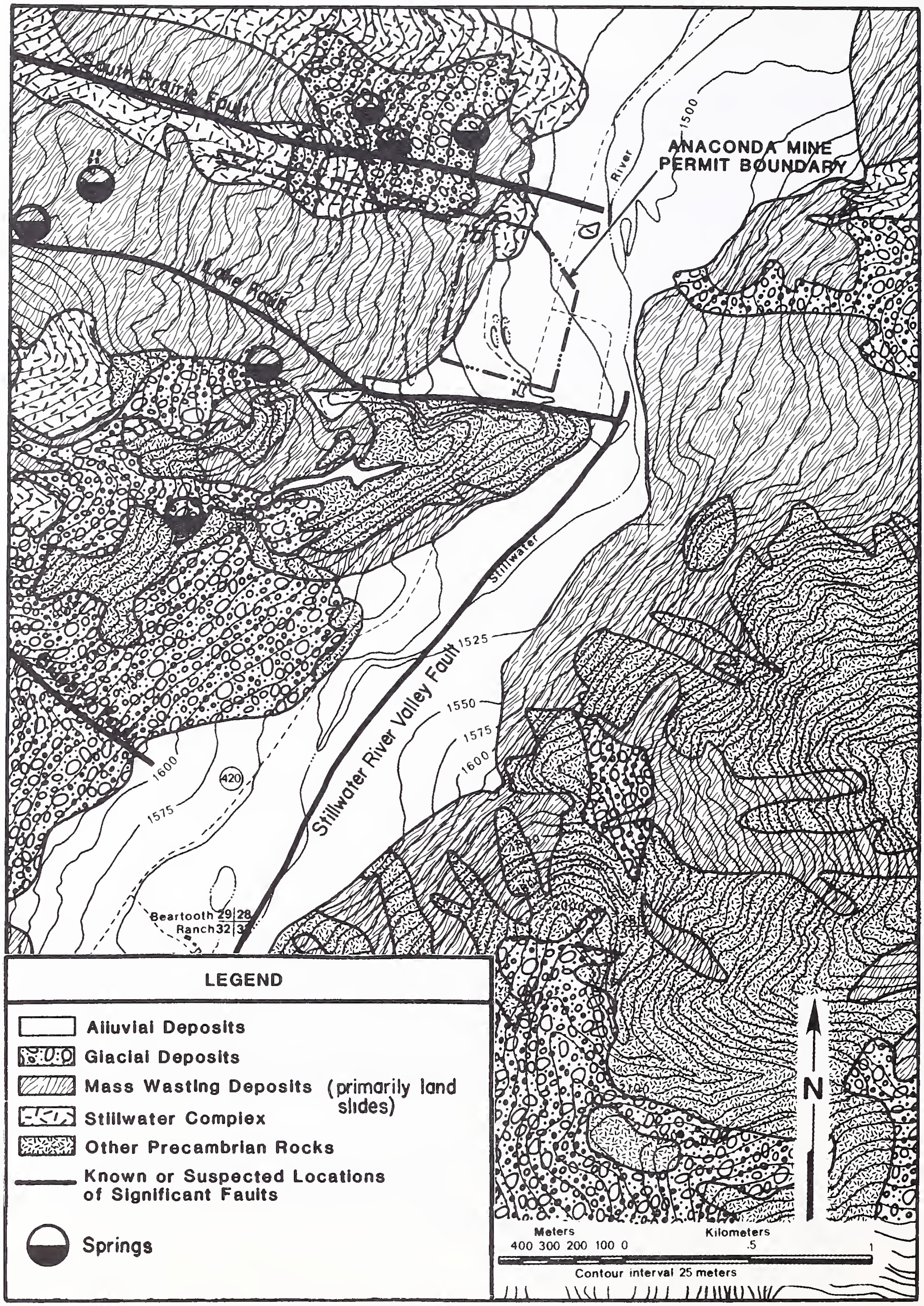


FIGURE III-4--Geology of the Minesite

Earthquakes. Based on earthquake locations documented over the last 30 years, the Stillwater River area appears to be an area of low earthquake activity. Areas within 100 miles are earthquake prone and have caused moderate ground shaking within the valley. The Hebgen Lake-Yellowstone Park area is one of the most active earthquake areas in the Rocky Mountains. The 1959 Hebgen Lake earthquake, measuring 7.1 on the Richter scale, caused ground shaking at Nye strong enough to break one water main, break dishes, crack foundations, and cause several rockfalls (modified Mercalli Intensity VI). This event is estimated to have produced peak ground accelerations of about 10 percent of gravity near Nye. The Hebgen Lake-Yellowstone Park area is the most likely area to cause ground shaking in the Stillwater River Valley in the future.

The nearest suspected active fault large enough to cause damage in the Stillwater Valley is the Emigrant Fault in the Yellowstone River Valley, about 32 miles west of the study area. The Emigrant Fault reportedly cuts recent (pliestocene) surficial deposits, indicating that it is probably still active (Witkin, 1975). One recorded earthquake measuring 4.2 magnitude (Richter scale) occurred in 1965 in the general vicinity of the Emigrant Fault (Camp, Dresser and McKee, [CDM] 1981, p. 2.7-51). Although no concrete evidence is available, the offset in recent surficial deposits along the Emigrant Fault point to this fault as the probable source of the earthquake. The fault is capable of producing up to a maximum magnitude of 7 earthquake because of its long length. A magnitude 7 earthquake, although very unlikely, could trigger large rockfalls or landslides, cause chimneys to break and fall, crack roads and bridges, and crack concrete foundations in the Stillwater River Valley. It could produce peak accelerations of about 17 percent in the Stillwater Valley.

Recent movement along local, small-scale faults has been reported adjacent to the study area in the following locations: near Little Rocky Creek, on the south slope of Contact Mountain, and to the north of Chrome Mountain. These features would only be capable of producing small earthquakes. One recorded earthquake, magnitude 4.0, occurred along the Beartooth front in 1965, indicating that the Beartooth Mountains are not totally inactive. The exact location of the quake is unknown. None of the larger faults within geology study area exhibit any evidence of recent movement (CDM, 1981).

Avalanches. There are numerous avalanche tracks on the steep slopes on both sides of the Stillwater River near the minesite, but the minesite itself is not within an identified avalanche corridor.

Slope failures. Slope failures ranging in size from small slumps to large landslides are present throughout the Stillwater Valley. Most of the failures occured during past ice age advances, which ended over 10,000 years ago. The landslides most often occurred in unconsolidated surficial deposits, but also developed in highly weathered bedrock. The wetness of the ice ages probably contributed to slope instability by saturating the surficial deposits.

Earthquakes causing ground shaking and postglacial stream downcutting may also have triggered some of the slides. Most of these slides are now well drained and are probable stable; however, some of the failures do have small ponds, bogs, and springs within them. Because water acts as a lubricant, decreasing particle cohesion, these saturated areas may be potentially unstable.

In June 1975, one small landslide occurred in the West Fork of the Stillwater River near where Johns-Manville was doing exploration work on the West Fork adit. (See fig. III-2.) The occurence of this landslide indicates that landslides in the region can happen when unstable material on steep slopes becomes saturated. In 1975 the snowpack was much deeper than usual in the month of June. Heavier than usual rainfall also occurred in the area that year. Because of these conditions, the shale and glacial material in this area became saturated and failed. Johns-Manville's activities near the slide probably were not a factor in causing this landlside (D.C. MacIntyre, Forest Supervisor, Custer National Forest letter to Mr. Miles Keogh, Nye, Montana, September 16, 1977).

Two landslides exist within and upslope of Anaconda's minesite. (See fig. III-4.) The boundaries of these landslides are probably somewhat larger than indicated on the map, especially downslope of the larger landslide. Landslide deposits associated with the largest landslide were encountered in drill holes and excavation work beneath Stillwater River terrace deposits near Anaconda's percolation ponds. This old landslide extended well into the Stillwater Valley and may at one time have temporarily dammed the river (Robert Hinshaw and Larry Prinkki, U.S. Forest Service, Region I, Geotechnical and Field Investigation staff, written commun. to Director of Engineering, December 15, 1981).

Despite considerable human activity (road construction, blasting, tunnel development) in and around these two landslides they have not moved to any discernible degree. Even the strong ground shaking caused by the 1959 Hebgen Lake earthquake did not cause them to fail. Even so, the largest landslide does have characteristics that are important to note: (1) much of the toe of the landslide has now been removed by the Stillwater River or by glaciers--the material resting upslope has therefore lost some support; (2) the landslide is upwards of 440 feet thick in its middle section; (3) Anaconda's permit area parallels the steepest, and probably the most unstable, part of the large landslide, and (4) several springs originate from the larger landslide.

Anaconda's upper support adit is located within the smaller landslide located north and just upslope of the larger landslide. As of December 1981, the support tunnel had been driven 440 feet horizontally, all in landslide debris. The texture of the landslide material ranges from sand-size particles to boulders several feet in diameter. Anaconda had to use massive metal beams to construct the upper support tunnel. Although construction methods included blasting, no discoverable

movement has been identified in the landslide (Hinshaw and Prinkki, 1981).

Preliminary field investigations done by Forest Service personnel determined that these two landslides appear to be fairly stable and have low probability of failure (Hinshaw and Prinkki, 1981). Even so, because of the above mentioned conditions, the possibility of these materials failing again cannot be totally ruled out. Further investigations will be done on these landslides. (See chapter IV, Geology, Geologic Hazards.)

Besides the known landslides, many of the geologic units within the study area were mapped as potentially unstable slopes by the geologic consultant hired by Anaconda. These areas have characteristics similar to areas that have failed. Natural environmental variables (erosion, earthquakes, moisture increases, and weathering) are considered to be more important factors influencing the stability of potentially unstable slopes and the existing landslides than are human factors. (See chapter IV, Geology, Geologic Hazards.)

b. Mill/tailing site

1) Topography and geomophology

Anaconda's proposed location for the mill/tailing site is a small north-facing tributary valley to the Hertzler Valley (elevation 4,800 feet). The Hertzler Valley, just over 2 miles long, is in turn a tributary to the Stillwater River. Bush mountain, elevation 5,200 feet, separates the mill/tailing site from the Stillwater Valley.

Hertzler Valley drops from 4,800 feet at its western end to 4,680 feet where it enters the Stillwater River. The topography of the valley is subdued. The small tributary that Anaconda proposes to fill with tailing is about one mile long and drains to the north. The upper end of this drainage starts at an elevation of 4,940 feet and drops to about 4,820 feet, where it enters the valley.

2) Surficial geology

The entire Hertzler Valley is covered by alluvial fan deposits (fig. III-5) that have coalesced, filling almost the entire valley with alluvial sediment. The fan deposits cover older glacial outwash material. (See fig. III-6.) The outwash deposits are upwards of 80 feet thick in the middle of the valley.

The mill/tailing site itself is entirely covered with glacial deposits. The deposits are comprised of pebble- to boulder-size framents up to 50 feet (average less than 5 feet) in diameter in a matrix of clayey, silty sand (CDM, 1981, p. 2.7-16). The thickness of the glacial deposits is variable and not well known.

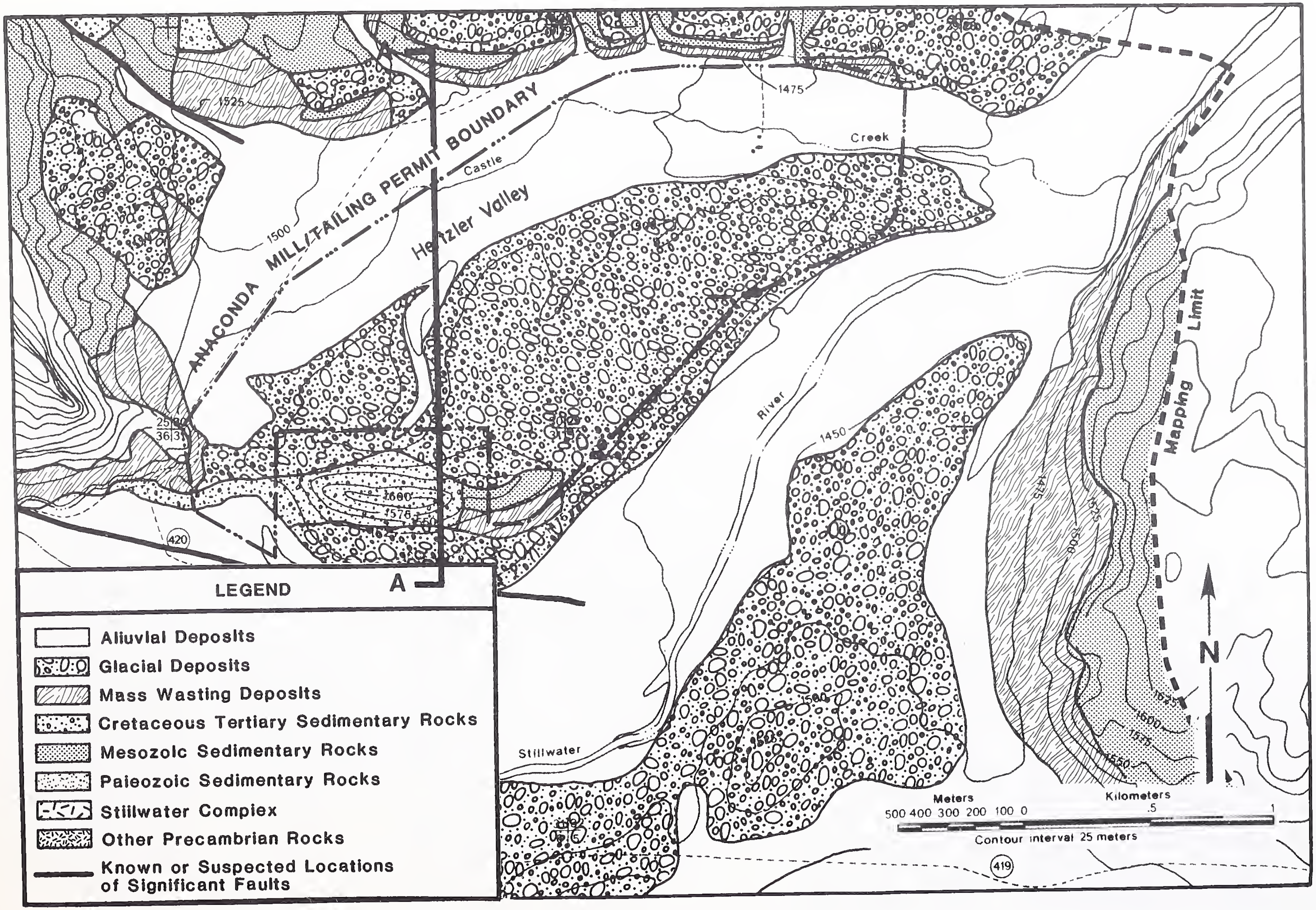


FIGURE III-5--Surficial Geology of the Mill/Tailing Site

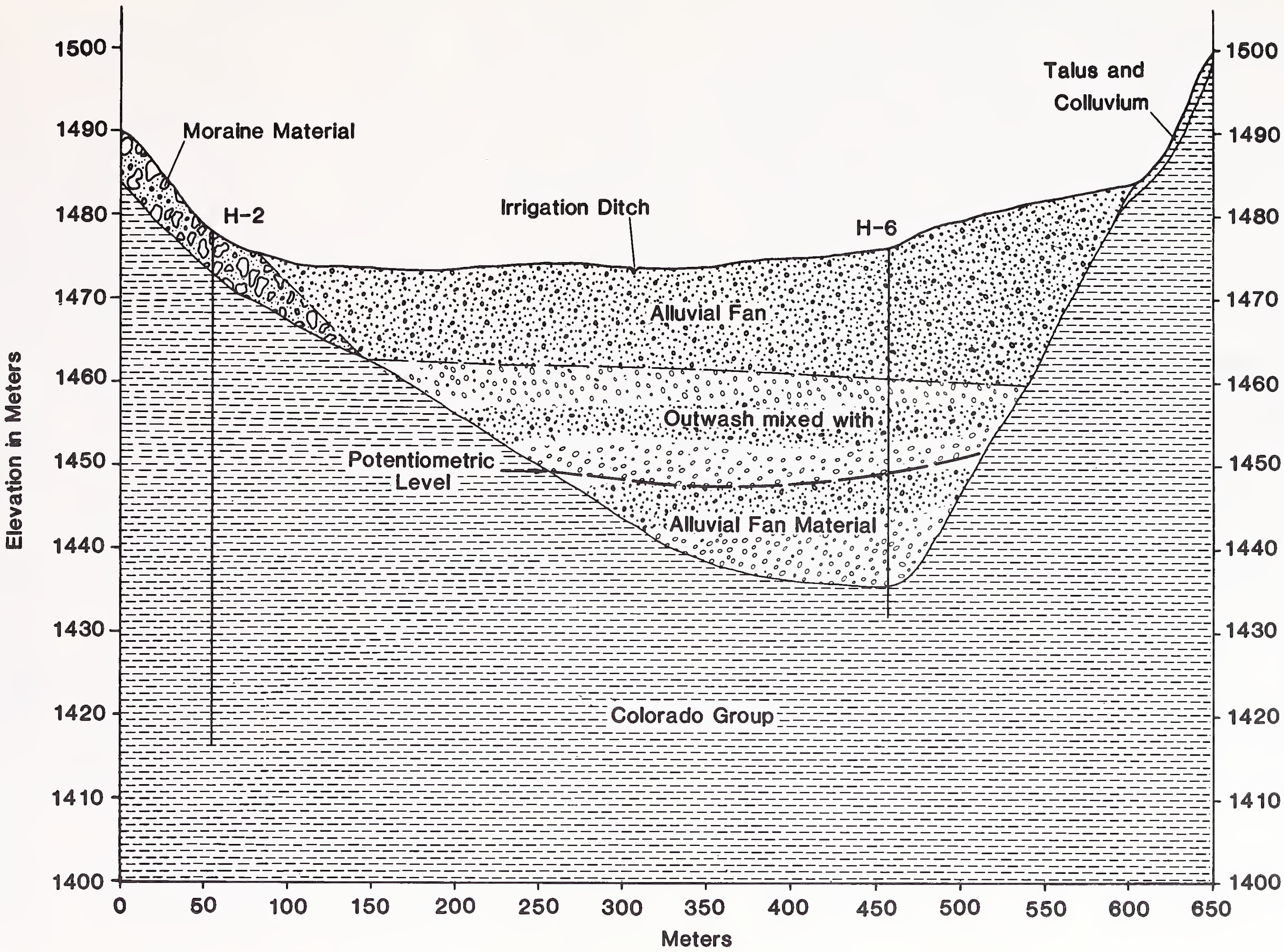


FIGURE III-6--Cross Section of Alluvial Deposits of Hertzler Valley
(See fig. III-5 for location of cross section.)

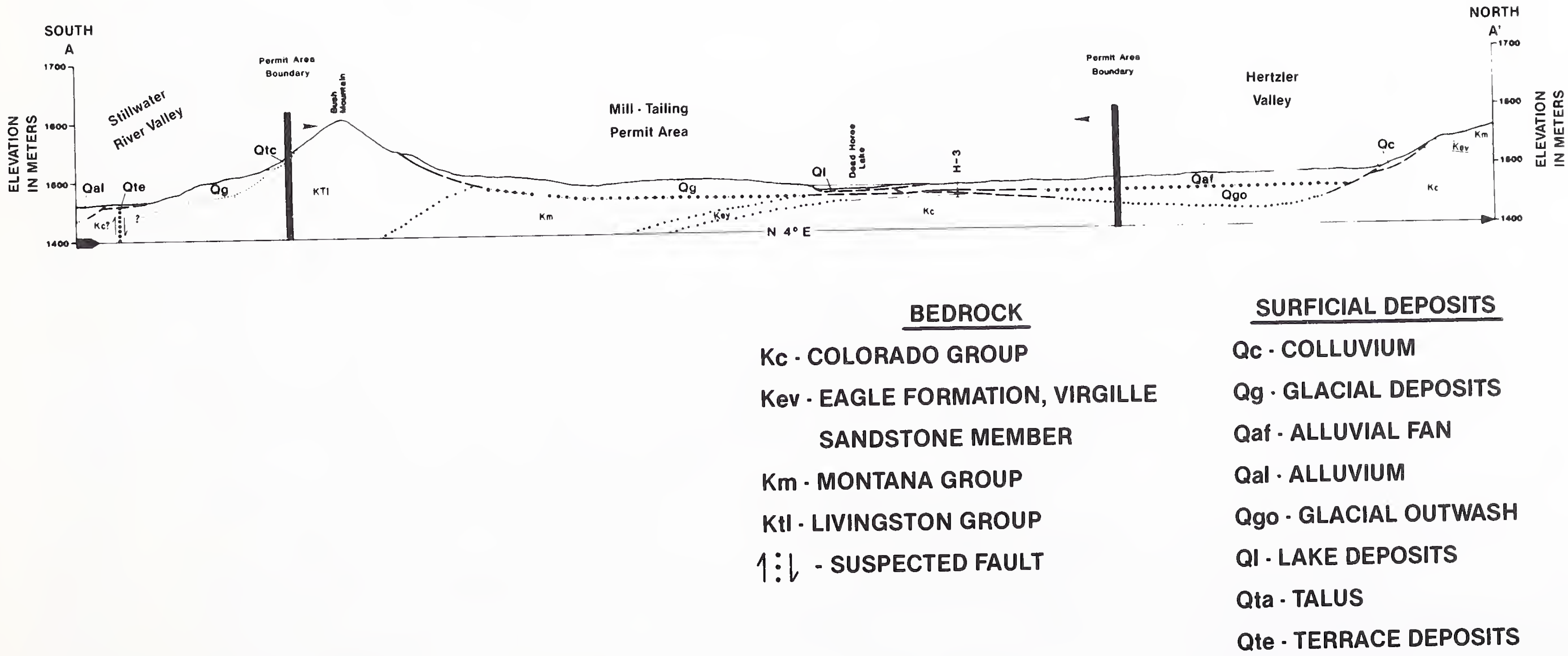


FIGURE III-7--Geologic Cross Section of Hertzler Valley, Showing Bedrock

3) Bedrock geology

Sedimentary rocks are the predominant bedrock units of the mill/tailing site as opposed to the igneous rocks of the minesite. The Colorado and Montana group sedimentary rocks are the two uppermost sedimentary bedrock units underlying the Hertzler Valley. The following discussion is limited to these two units because deeper units would not be part of the potentially affected environment. (See fig. III-7.)

The Colorado Group rocks, the deepest bedrock units identified in the valley, are composed mostly of shale with smaller horizons of interbedded sandstone. The total thickness of the Colorado group rocks is between 2,300 and 3,300 feet. The Montana Group, overlying the Colorado Group rocks, consists of a 100-foot-thick sandstone unit (Virgelle Sandstone) at the bottom. Above that are alternating layers of shale and fine-grained sandstone. Still higher in the sequence is fine-grained silty sandstone. The total thickness of Montana group is between 650 and 700 feet (CDM 1981, p. 2.7-14). A thin coal seam also exits near the base of the undifferentiated Montana group rocks. The high percentage of shale rocks in the Colorado and Montana Group rocks severely restricts ground water movement through them. (See Hydrology, Ground Water.)

4) Structural Geology

The Hertzler Valley is located at the northwestern end of the Nye-Bowler lineament, which is believed to be the surface expression of a major flaw (series of wrench faults) in the crust. The flaw probably extends to deep depths (Jones et al., 1960, p. 308). The Nye-Bowler lineament does not appear to be a structurally active area at present, but it has been the site of dramatic faulting and folding in the geologic past.

Two major faults have been identified in the general vicinity of Hertzler Valley area. Surficial deposits cover the underlying bedrock of the mill/tailing site; whether faults are present within the site is therefore unknown.

5) Geologic hazards

Most of the land within the mill/tailing area is covered with glacial deposits. For the most part, this glacial material is stable, although, there are some areas that have the potential to be unstable. (See fig. III-8.) The Bush Mountain area is probably capable of landslide or rockfall, as are very small acreages around the Dead Horse Lake. The unconsolidated deposits in these areas are resting at steep angles. These potential unstable slopes pose little hazard to cattle grazing, the existing land use.

The mill/tailing site is roughly 7 miles northeast of the minesite and is that much farther from known areas of frequent earthquake activity. (See Minesite.) The potential for severe earthquake ground

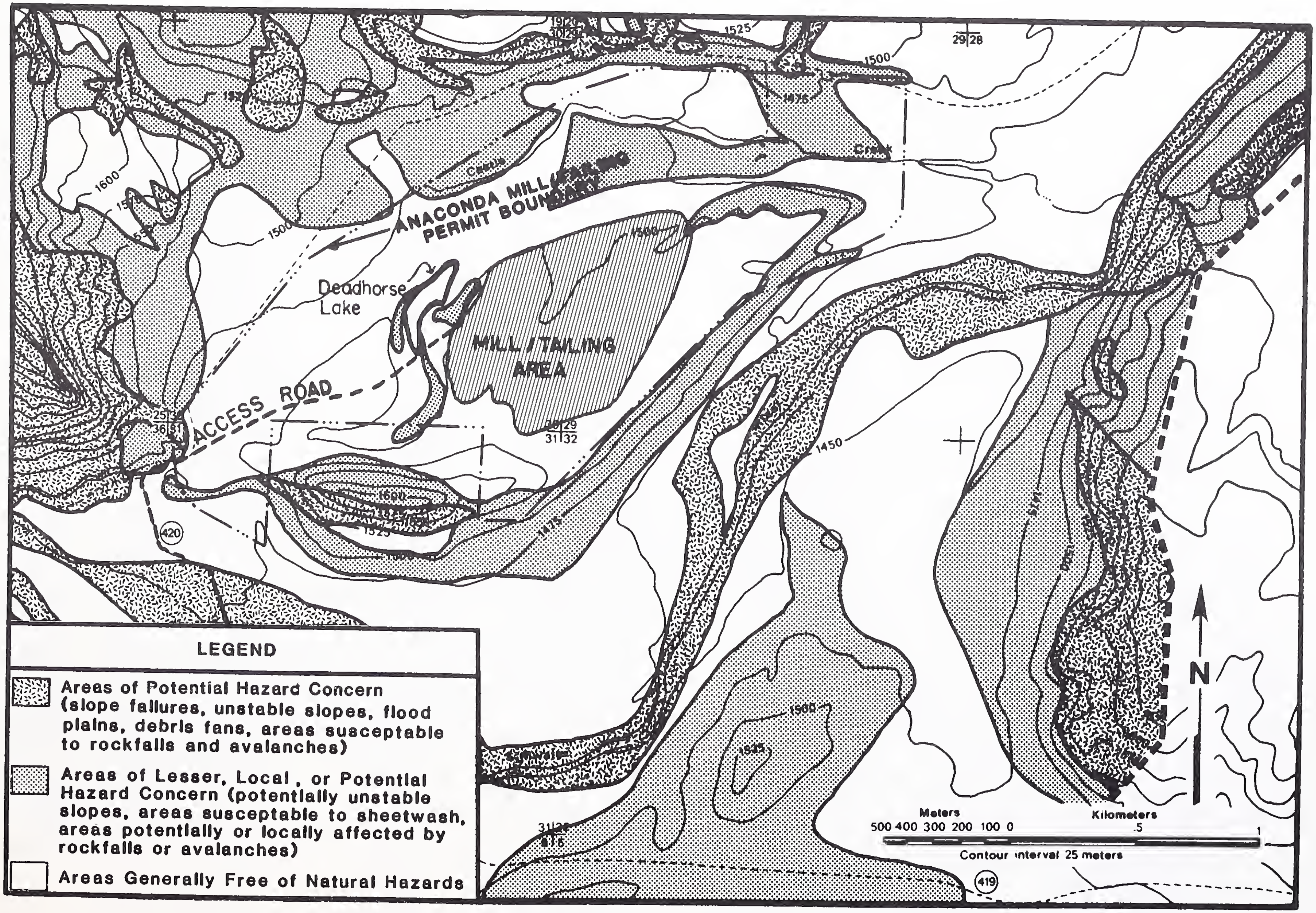


FIGURE III-8--Geologic Hazards Map of Mill/Tailing Site

shaking is therefore less than that of the mine area. The overall geologic hazard potential for the mill/tailing area is low.

B. HYDROLOGY

1. Surface Water

a. Stillwater River

The Stillwater River flows adjacent to the project area. It is within one-quarter mile of the minesite, generally less than a mile from the transportation corridor, and within three quarters of a mile of the mill/tailing site. (See fig. I-1.) All water that flows off the project area drains into the Stillwater River. Most other drainages within the southeastern portion of the Beartooth Mountains also flow into the Stillwater River.

Flows in the river usually peak during June or July from snowmelt and increased precipitation. Roughly three fourths of the annual runoff occurs in May, June, and July (Camp, Dresser and McKee, [CDM] 1981, p. 2.2-4). By Woodbine Campground (about 3 miles upstream of Anaconda's mine facilities) the maximum peak flow recorded during the period of June 1980 to June 1981 was 2,180 cubic feet per second; the lowest flow recorded was 35 cubic feet per second (January 1981) or 5 percent of the maximum flow. (The drainage area of the Stillwater River above this point is about 160 square miles.) The upper Stillwater basin has a high average annual precipitation rate (20-40 inches/year) and rough topography (maximum relief is 6,400 feet), which accounts for the wide range in water flow and high spring runoff.

The 100-year and 500-year flood-prone areas for the Stillwater River Valley north of the Custer National Forest boundary were outlined by the Soil Conservation Service in 1979 (CDM, 1981, p. 2.7-36). CDM (Anaconda's hydrology baseline study consultant) outlined the potential floodplain of the Stillwater south of the Custer National Forest boundary using physical evidence of past flooding. Based upon these two studies, Anaconda's mine permit area is totally outside the estimated 500-year floodplain of the Stillwater River.

Surface water quality within the Stillwater River Basin is generally good to excellent, reflecting the undeveloped state of the area (Mid-Yellowstone Areawide Planning Organization, 1978) and the general lack of geologic strata that are capable of creating poor water quality. The Stillwater River is classified as a B-1 type by the Montana Department of Health and Environmental Sciences, meaning the water is generally suitable after conventional water treatment for drinking, cooking, and food processing. The water may be used without further treament for bathing; swimming; recreation; growth and propogation of trout fisheries and associated aquatic life, water fowl and fur-bearers; and agricultural and industrial supply.

Total dissolved solids (a rough measure of the salinity of water) is typically very low, usually below 100 milligrams per liter (mg/l). Dissolved solids, alkalinity and hardness increase in a downstream direction within the Stillwater River, which is a typical occurrence in streams of the region. The water is generally soft, is low in dissolved solids (11-152 milligrams/liter), is between 6.3 to 9.9 in pH (7 pH is neutral), and has a calcium bicarbonate composition. The river has a low buffering capacity because its water has fairly low alkalinity (1980-81 one-year average for the upper Stillwater River was 60 mg/l). A large amount of acidic water if introduced would affect the pH of the river. The river also exhibits low hardness (one-year average of upper Stillwater River was 34 mg/l). Water low in hardness tends to increase the toxicity of metals to aquatic organisms (McKee and Wolf, 1974), although no detrimental adverse effects on aquatic life have been documented in the Stillwater River as a result of metals. (See Aquatic Ecology.)

Although water quality is excellent in most stretches of the Stillwater River, a number of locations have natural concentrations of cadmium, lead, and manganese that occasionally exceed drinking water standards set by the U.S. Environmental Protection Agency (1980) and the Montana Department of Health and Environmental Sciences (1980). The standards, 0.01 mg/l for cadmium, 0.05 mg/l for lead and 0.05 for manganese, were established for water sources used by humans on a continuous basis.

Iron levels in the Stillwater River and some of its tributaries occasionally are also above the criteria established by the EPA for domestic water supplies (American Fisheries Society, 1979, p. 121). Iron levels above the criteria level of 0.3 mg/l are not necessarily harmful--humans have a very high tolerance for iron. Rather, the levels were established for aesthetic purposes (taste and clothes washing).

The elevated levels (total rather than dissolved) of iron, lead, and manganese occur during periods of peak flow, when sediment transport is highest (Anaconda Permit Application, 1981). Most of the metals are probably attached to the sediment. Filtration of the water would remove most of these metals along with the sediment. Likewise, the metal-laden sediment would drop out of suspension if the water were allowed to stand motionless. Because these metals are attached to sediment, their impact to human uses and the aquatic community of the river are negligible.

Cadmium levels, by contrast, are highest during low-flow periods, indicating a majority of the cadmium is dissolved, rather than suspended in the water. Standard filtration processing of the water probably would not remove much of the cadmium. As a precaution, humans should not drink water from the river during low-flow periods. The elevated cadmium levels in stretches of the river may adversely affect sensitive species of the aquatic community during low-flow periods.

Although the source of the elevated iron, lead, manganese, and cadmium levels has not been determined, they probably result from weathering of bedrock in the upper Stillwater River Basin. For example, Verdigris Creek and the West Fork of the Stillwater River drain portions of the Stillwater Complex that contain sulfide and metal values above those normally found in the basin (CDM, 1981, p. 2.2-113). Accordingly, high average metal concentrations were found to be associated with channel sediments downstream of the confluence of these creeks and the Stillwater River.

b. Tributaries to the Stillwater River

Water quality and quantity measurements were conducted on Verdigris Creek, Nye Creek, Mountain View Creek, and the West Fork of the Stillwater River. (See fig. III-3). All of these streams flow only part of the year, except for the West Fork of the Stillwater River, which flows year-round. Verdigris, Mountain View, and Nye Creeks are alpine-subalpine tributaries to the Stillwater River.

The tributary streams of the Stillwater River have variable water quality. The alpine and subalpine creeks of the upper half of the Stillwater River basin generally have low dissolved solid values and creeks of the lower half generally have higher conductance-dissolved solids. Water quality within the tributaries is generally poorest during low-flow periods.

Verdigris Creek runoff water contains high levels of sulfate. This stems from the weathering of small pockets of sulfide minerals (pyrrhotite, pentlandite and chalcopyrite) in the bedrock of the middle portion of the Stillwater Complex across which the creek flows. These pockets produce sulfate complexes and slightly acidic water upon weathering. In Verdigris Creek, the sulfates become especially concentrated during low-flow periods (late summer and winter). Cadmium and iron levels also occasionally exceed criteria for drinking or domestic water supplies. The diversity of aquatic invertebrates within Verdigris Creek was less than other nearby creeks, indicating that metals within the water may be adversely effecting aquatic life. (See Aquatic Ecology.)

Verdigris Creek cuts across a large ancient landslide and during high flow spring runoff it picks up tremendous amounts of sediment. The channel is constantly cutting into the landslide material causing large blocks of material to fall into the creek (Jim Harrower, Anaconda Minerals Company, April 22, 1982). For its size this creek contributes a large proportion of suspended and bedload sediment to the Stillwater River.

Nye Creek, located on the southeast side of the Stillwater River Valley, directly across from the proposed mine, drains an area of about 4 square miles. Chromium, iron, and magnesium levels have been measured

well above suggested levels set by the EPA (1980) for drinking and domestic water supplies (0.01 mg/l for cadmium, 0.30 mg/l for iron, and 0.05 mg/l for magnesium). The diversity of aquatic invertebrates within Nye Creek is also low and may indicate adverse effects of metals on the aquatic community. (See Aquatic Ecology.) The Stillwater Complex, as it cuts across the Stillwater Valley, occupies a large percentage of the Nye Basin. This probably accounts for the elevated sulfates and metals in Nye Creek. Nye Creek cuts through the area where old tailing from the chromite mines were deposited (on the terraces of the Stillwater River). Wind-blown tailing is a major source of suspended sediment in the creek (Phil Jaquith, Custer National Forest, District Ranger, oral commun., April 15, 1982).

Mountain View Creek is just outside the southern boundary of the minesite part of the permit area. It originates from Mountain View Lake and flows almost due east toward the Stillwater River. The topography between the lake and the river is moderately steep. The creek has relatively low peak flows, owing to its small drainage area.

Water within Mountain View Creek was sampled for water quality on two occasions. The water was good enough to be used for drinking water, but chromium levels may be high enough to slightly reduce productivity of sensitive species of aquatic life (CDM, 1980).

Anaconda has tapped the overflows from Mountain View Lake to supply water to the upper support adit for drilling. Roughly 25 gallons per minute of water is drawn out from the lake for periods of about 6 hours a day (Hydrometrics, 1981). This withdrawal has had no discernible effects on the lake or the creek.

In places, the West Fork of the Stillwater River has cadmium and iron levels slightly above EPA criteria for drinking and domestic water supplies. The same Stillwater complex rocks high in pyrite described above underlie portions of the West Fork Basin and are likely the cause of the reduced water quality. Overall the presence of aquatic invertebrates that are sensitive to environmental degredation indicates that the West Fork of the Stillwater River generally has good quality water.

c. Minesite

The majority of the minesite is drained by very small ephemeral drainages that flow directly into the Stillwater River. No attempt was made to sample these drainages.

Anaconda is now pumping ground water out of the Minneapolis adit. This water is temporarily retained in a series of percolation ponds before it enters the ground water system of the Stillwater River. (See Ground Water). To date, no surface water discharge from these ponds has occurred. The percolation ponds are sufficiently large that no surface water discharge is expected. (See chapter I.)

To date, the quality of water coming out of the Minneapolis adit has been good. (See Ground Water). No impacts on the surface waters of the area have occurred from Anaconda's exploration activities.

d. Mill/tailing site

Two small, poorly developed coulees with no distinct drainage channels drain the mill/tailing site. Both drainages originate at the base of Bush Mountain and end in Hertzler Valley. Because the underlying material (glacial debris) is extremely porous, the two drainages probably would not carry runoff waters. Rainfall and snowmelt falling on the mill/tailing site would usually infiltrate into the glacial material and become ground water.

No surface runoff occurred in the two small drainages occupying the mill/tailing site during the one-year sampling period (July 1980 to July 1981). Therefore, no water quality analyses are available.

Castle Creek flows down the center of the Hertzler Valley and has a small, indistinct drainage channel. An irrigation ditch that brings water from the West Fork of the Stillwater River does fill the channel (near the Hertzler Ranch) during the irrigation season, but the Castle Creek channel is normally dry.

Runoff waters flowing into the Hertzler Valley from the north (Robinson Draw, Stanley Coulee, and Tandy Coal Mine Draw; see fig. I-6.) all appear to flow into the irrigation ditch, rather than reaching the Castle Creek channel directly. All three drainages are ephemeral, meaning they flow only in response to rapid snowmelt or intense rainstorm events. Runoff within these drainages occasionally contains constituent levels--cadmium and iron most often--above standards set for drinking water. Fecal coliform and sulfate values were also found to occasionally exceed recommended drinking water criteria (EPA, 1981, and Montana Department of Health and Environmental Sciences, 1980). The bedrock (Eagle Formation) underneath these drainges contains sulfide metal complexes that slightly acidify runoff waters and probably are the reason for the elevated cadmium and iron values. Even though these waters are unsuitable for human consumption, they are of good enough quality for irrigating and stockwatering.

2. Ground Water of Minesite

At the minesite two distinct groups of geologic units contain ground water: bedrock units and unconsolidated surficial deposits.

a. Bedrock aquifer

Bedrock lies on both sides of the Stillwater River and beneath the alluvial and other surficial deposits that occupy the valley. (See fig. III-4.) Ground water in the bedrock is mainly confined to openings such as joints, faults, and shear zones. The amount of ground water that could be extracted is difficult to predict and is highly variable; it

would depend on the size, frequency, and nature of the interconnections of the joints, faults and shear zones (Anaconda Permit Application, 1981, p. 2.3-20). Although flows appeared to go in one general direction, the natural variability makes accurate ground water flow predictions impossible. (Anaconda Permit Application, 1981, p. 2.3-46). For this reason bedrock in the upper Stillwater Valley Basin would not be a good unit to drill into for the sole purpose of obtaining water.

Large influxes of ground water into the Minneapolis adit were not encountered during excavation of most of the cross cuts and drifts, with the exception of one area. In that area, significant flows (170 gpm) were found in faults and shears that paralleled the banding of the Stillwater Complex rocks. Flows estimated at the working face of the adit ranged from less than 1 gallon per minute (gpm) to 170 gpm. The total discharge of the adit peaked in June of 1980 at 270 gpm and has averaged about 110 gpm since then. All flows from fractures and drill holes typically decreased with time to low, constant discharge rates.

Recharge of the bedrock ground water system probably occurs mostly at higher elevations, where snowmelt and rain infiltrate and percolate along joints, fractures, and bedrock discontinuities. Some recharge to the bedrock may occur via infiltration of ground water from saturated alluvial or other unconsolidated deposits located along the flanks of the Stillwater River.

Ground water leaves the bedrock as (1) surface springs and (2) discharge to unconsolidated subsurface materials low in the valleys and draws of the region. The locations and distribution of these discharge points are probably controlled by the distribution of bedrock fractures, faults or discontinuities. Fourteen springs have been identified between the mine and mill sites. Nine of these have been developed for domestic or livestock water supply (CDM, p. 2.3-23).

Ground water discharge from bedrock most likely contributes significantly to alluvial ground water and possibly surface water system(s) of the Stillwater River. Bedrock discharge along with infiltrated surface runoff from snowmelt both contribute to the perennial character of the Stillwater River (Anaconda Permit Application, 1981, p. 2.3-22).

Anaconda's exploration adit has modified the flow pattern of ground water immediately around the excavations. Prior to Anaconda's exploration work, the ground water intercepted by the underground working would probably have flowed toward the Stillwater River Valley. Now it flows into Anaconda's excavations and is directed to percolation ponds where it seeps into the alluvium of the Stillwater River.

The dewatering of bedrock around Anaconda's Minneapolis adit may have reduced the flow of a spring that was used as the sole water supply to the Hjelvik residence located 500 feet downslope of the Minneapolis adit. Anaconda has replaced the Hjelviks spring fed water supply with water from a well drilled into Stillwater River alluvium. Adverse

effects of Anaconda's activities on other springs in the area have not been reported or suspected.

b. Unconsolidated deposit aquifers of the minesite

The alluvium along the Stillwater River is the major source of ground water in the valley. (See fig. III-10 for conceptual view of the valley alluvium.) The general flow direction for the Stillwater River alluvial ground water is downstream, or from the south and west to the north and east. The Stillwater alluvium is capable of producing upwards of several hundred gallons a minute without a noticeable reduction. At least 17 wells are known to produce water from the alluvial deposits in the upper Stillwater River Valley. Fifteen of these are used as domestic water supplies.

Other surficial deposits of mass-wasting and glacial origin are present throughout the project area. These consist of talus, landslide deposits, glacial deposits, and other forms of loose, heterogeneous and incoherent material deposited chiefly by mass wasting.

The landslide deposits are variably saturated because of their jumbled physical and textural properties. Numerous springs found in the Beartooth Mountains are associated with landslide deposits. Several springs issue from the large landslide located immediately to the north of the Minneapolis adit area. (See fig. III-4.) Within the Stillwater River Valley one spring associated with a landslide has been developed for domestic use and several others are used by livestock and wildlife.

c. Ground water quality of the minesite

1) Bedrock

Ground water is generally of drinking water quality in both the bedrock immediately surrounding the Minneapolis adit and in the platinum-group metal zone. Sulfide and metal values are low in this zone. (See Geology.) In contrast, bedrock within the Stillwater Complex further away from the platinum-group metals contains considerably higher amounts of sulfides; therefore, ground water passing through these areas is expected to have higher metal values than most of the ground water in the upper Stillwater River basin. Indirect evidence of poorer quality water in bedrock surrounding the platinum zone comes from three wells (fig. I-4) drilled in the Stillwater River alluvium immediately downgradient of the existing percolation ponds. Bedrock areas with high amounts of pyrite probably also contribute to the poor quality of water in Verdigris and Nye Creeks and the West Fork of the Stillwater River. (See Surface Water, Tributaries to the Stillwater River.)

2) Unconsolidated deposit aquifer

The only ground water well in the unconsolidated deposits of the Stillwater Valley that is upgradient of the minesite is located at the

Beartooth Ranch. The ground water in this well is of very good quality with measured values well below the limits set for drinking water. The Stillwater River Valley alluvial deposits generally have very good quality water, although localized areas within the alluvium do have water that would be unacceptable to drink because of elevated metal values. The location of all such areas are not known, but several areas with elevated metals in alluvial ground water exist close to the minesite.

The three observation wells immediately downgradient of the Minneapolis adit were completed in the alluvium of the Stillwater River. Ground water samples from these wells exceeded drinking water limits for one or more of the following constituents: total dissolved solids (TDS), chromium, iron, and selenium. Ground water passing through mineralized bedrock is probably the major contributor to the elevated metal values. No other major source could reasonably be responsible. Discharge from the chromite adit, located in the Mountain View Lake drainage due east and up slope from the wells, does not have high enough chromium levels to account for the high levels in the wells. The government stockpile of chromite located only a few hundred yards from these wells is also an unlikely contributor because the stockpile is probably downgradient of the wells. (See fig. IV-1.) The stockpiles may locally affect alluvial ground water quality underneath the stockpile. Seepage out of the Minneapolis adit percolation pond is probably not the major contributor to the elevated levels in the three wells, since the quality of the discharge water is better than that found in the wells. Natural seepage of ground water through minerals and bedrock located west and south of these wells is thought to be the major source of constituents that are found to be above drinking water standards.

Three additional observation wells were drilled in the alluvial deposits under an old chromite tailing pond disposal area, located on the terraces of the Stillwater River opposite Anaconda's present mine site. Water samples collected exceeded the drinking water limits for iron, lead, manganese, cadmium, and chromium. The old chromite tailing may be a contributor of metals to the alluvial ground water system, as might the natural seepage of mineralized bedrock ground water. (Nye Basin, located upgradient and to the east of this tailing pond area, contains Stillwater complex rocks with high concentrations of sulfides and metals. Water in Nye Creek has elevated metal values.)

3. Ground Water of the Mill/Tailing Site

Ground water in the Hertzler Valley is primarily found in two distinct geologic units: sedimentary bedrock and unconsolidated surficial deposits. (See fig. III-6 and III-7.) The majority of the Hertzler Valley and the mill/tailing site is underlain by sedimentary shale and sandstone units. (See Geology, Bedrock). Surficial deposits cover the bedrock throughout much of the mill/tailing site.

a. Sedimentary bedrock

Ground water is available in the sedimentary units, but generally is not used where more reliable sources exist. Overlying unconsolidated surficial deposits generally can produce adequate quantities of ground water at shallow depths.

Ground water in the sedimentary rocks of the Hertzler Valley generally flows toward the valley bottom, roughly following the relief of the landscape. Much of the lower elevation areas of the valley are underlain by bedrock composed of shale (Colorado Group). The Colorado Shale is roughly 1000 times less permeable than the overlying sand and gravel: the shale does not allow easy passage of ground water. This limits to some extent the amount of vertical leakage from the overlying surficial deposits. Alluvial wells, when pumped, slightly dropped the level of water in observation wells completed in the shale, which indicates that the upper portion of the shale bedrock is to a small degree hydrologically connected with the overlying saturated unconsolidated material and that some exchange of ground water between the two units is possible.

b. Unconsolidated surficial deposits

The depth of unconsolidated material within the Hertzler Valley varies. The thickest accumulation occurs along the central east-west axis of the valley. (See fig. III-7.) The material is composed primarily of a mixture of alluvial fan and glacial outwash deposits. Ground water moving through the unconsolidated deposits moves through the basal part of the material (primarily cleaned glacial outwash) in an unconfined (nonartesian) state.

During most of the year, these unconsolidated deposits are saturated with ground water at depths ranging from 90 feet in the western end of the valley to 40 feet in the eastern end, where the Hertzler Valley joins the Stillwater River. (See fig. III-9.) Water levels vary with the season: the watertable is highest during the late spring and summer, lowest during winter and early spring. It rises as much as 20 feet from low to high periods.

Ground water always moves from higher to lower ground water table elevations, (perpendicular to the contour lines shown on figure III-9). In the Hertzler Valley, ground water moves down the axis of the valley, from west to east, eventually reaching the Stillwater River Valley. Because the bedrock underlying the valley is of such low permeability, the vertical loss of alluvial ground water to the underlying bedrock is minimal.

Ground water can be extracted from the unconsolidated deposits of the Hertzler Valley at high rates. Several observation wells drilled by Anaconda were capable of producing more than 200 gallons per minute (gpm), sufficient for sprinkler irrigation of hay fields.

Infiltration of irrigation waters is a major source of recharge for the valley ground water system: over half (600 gpm) of the irrigation water brought in from the West Fork of the Stillwater River is lost to infiltration (Anaconda Minerals Company, written commun. October 1981). The irrigation ditch (mentioned under Surface Water) runs most of the length of the Hertzler Valley and is used to flood-irrigate hayfields.

c. Water quality

The quality of ground water in the unconsolidated deposits of the Hertzler Valley is poor to excellent, depending on what the water is used for. All six observation wells drilled by Anaconda in the unconsolidated deposits tapped groundwater of suitable quality for use in irrigation or stock watering, now the water's primary use. Valley ground water was found to be consistently above the recommended drinking water limit for iron. Three of six observation wells also had lead values above the recommended limit for drinking water (4-15 times the drinking water standard). Manganese was above the drinking water limit of 0.05 mg/l for four of six wells in the valley. (See table in chapter IV, Hydrology, Ground Water, wells HIA, H3, H4, H5, H6, and H8.) In general, alluvial ground water most of the Hertzler Valley would not be desirable for domestic water supplies. The origin of the constituents that make the water undesirable for drinking water are unknown, but probably are a result of poor quality water seeping upwards from the underlying bedrock and from infiltration of surface water. (See Surface Water, Mill/Tailing Site.)

Water quality samples taken from two observation wells (H2 and H7) completed in the bedrock that underlies most of the valley (Colorado Shale Group) exceeded the drinking water limits for the following constituents: total dissolved solids, arsenic, cadmium, chromium, iron, lead, manganese, selenium, silver, and sulfate. The poor quality of the water in the Colorado Group rocks, coupled with the very small amount of ground water that could be pumped from the units, makes the Colorado Shale an undesirable ground water source.

The only reported domestic well (R.L. Curtin) in the Hertzler Valley is located within a small unnamed tributary along the north central part of the valley. (See fig. III-9.) The water quality of this well is good; the concentrations of water quality variables are well below drinking water standards.

C. SOILS

The soils within and near the Anaconda Stillwater Project area have been mapped at two levels of intensity. A detailed (Order I) soil survey was conducted on about 5,320 acres, including the 780-acre proposed permit area. The remainder of the 24,500-acre study area was mapped at a broader (Order III) level.

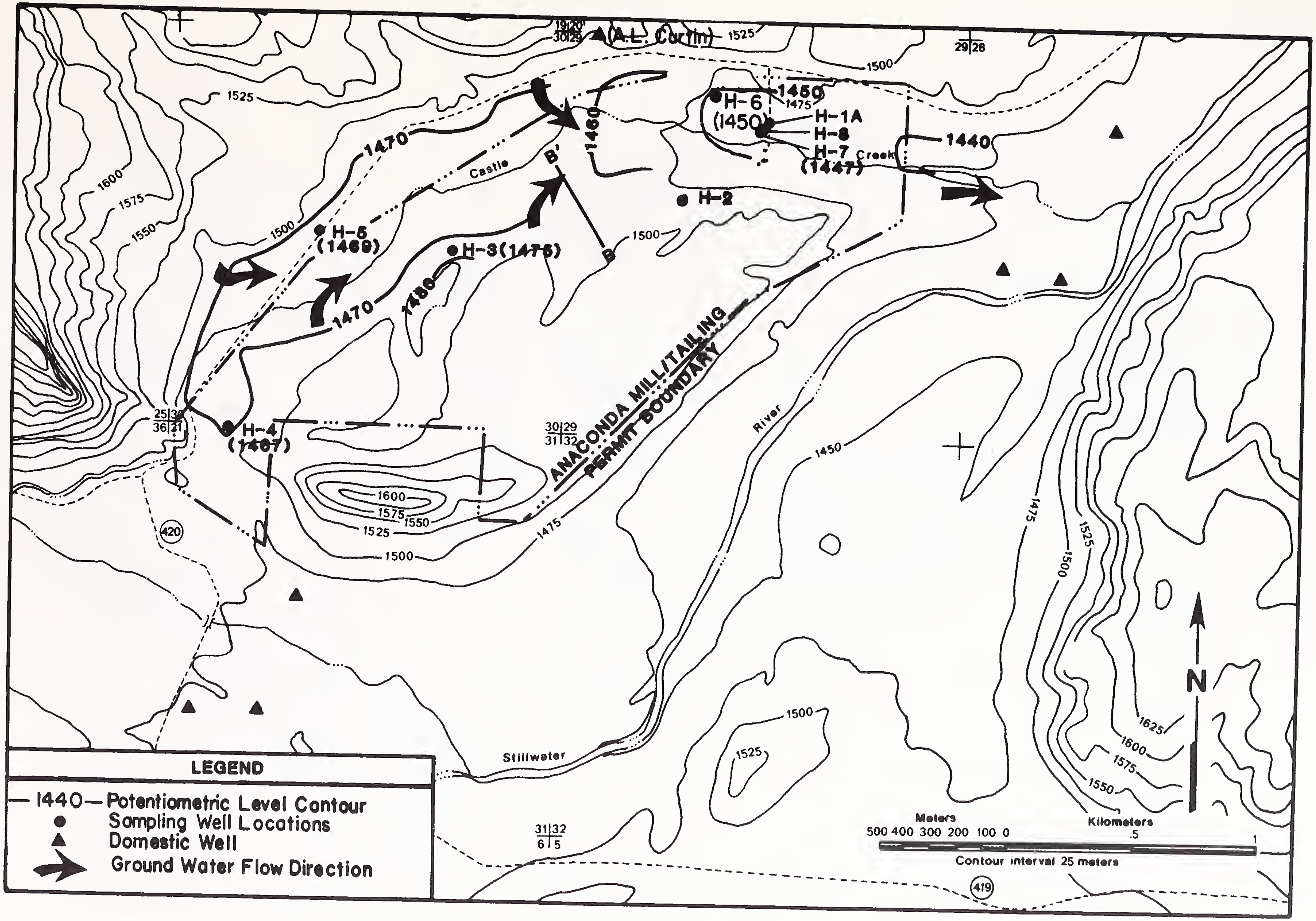


FIGURE III-9--Potentiometric Map and Ground Water Sampling Locations in the Mill/Tailing Area

1. Overview

The soils in the area studied are variable. This variability stems from differences in climate, vegetation, parent material, topography and time of development (age). In this mountainous area, climate and vegetation are the two predominant factors affecting soil formation. The climate of the region, classified as "mountainous continental," is characterized by large diurnal and annual temperature ranges, as well as marked differences in precipitation and wind patterns over a distance of only a few miles. (See Climate.)

A noticeable vegetative and soil change takes place at an altitude slightly above 5,000 feet. Scattered ponderosa pine, Douglas-fir, lodgepole pine, and limber pine generally predominate above this altitude; grass cover predominates below. This creates differences in the soil. As plants die and decompose, they contribute litter and organic acids to the soil. Soils that are formed under grassland at lower altitudes do not leach readily and the subsoils are usually calcareous. The organic matter from the grasses is responsible for the characteristically thick, dark-colored, neutral to mildly alkaline surface (A_1) horizon of these soils.

Litter from a coniferous forest is more acidic than that from grass. At an altitude above 6,000 feet (1,828 meters) precipitation increases, temperature decreases, and the soils become more acid with a lower base exchange. Soils thus develop under conditions of acid hydrolysis. They are characterized by a relatively thin surface (A_1) horizon, a light ashy-colored eluvial (leached) horizon below the surface horizon, and a reddish-colored illuvial (accumulation) horizon below the eluvial horizon.

In the area studied, the materials from which the soil developed (soil parent materials) were derived from locally weathered bedrock or were transported from higher elevations of the Stillwater drainage. The transported material was moved by gravity, wind, glaciers, or water to its present location. Glaciation and water action have performed the dominant role in the evolution of valley topography. Glaciers have left stones--and streams have deposited alluvial gravels--that cap terraces and benches along the valley, as illustrated in figure III-10. This figure also shows representative soil series for various topographic and geologic locations.

The landscape of the project area exhibits a general soil-plant relationship. The nature of the soil and parent materials determine the kind and, to a considerable extent, the distribution of vegetation, since plant growth is heavily dependent on the chemical and physical characteristics of the soil. However, such factors as past land use practices, micro-relief, and micro-climate may have altered the expected soil-plant relationships in some areas of the valley.

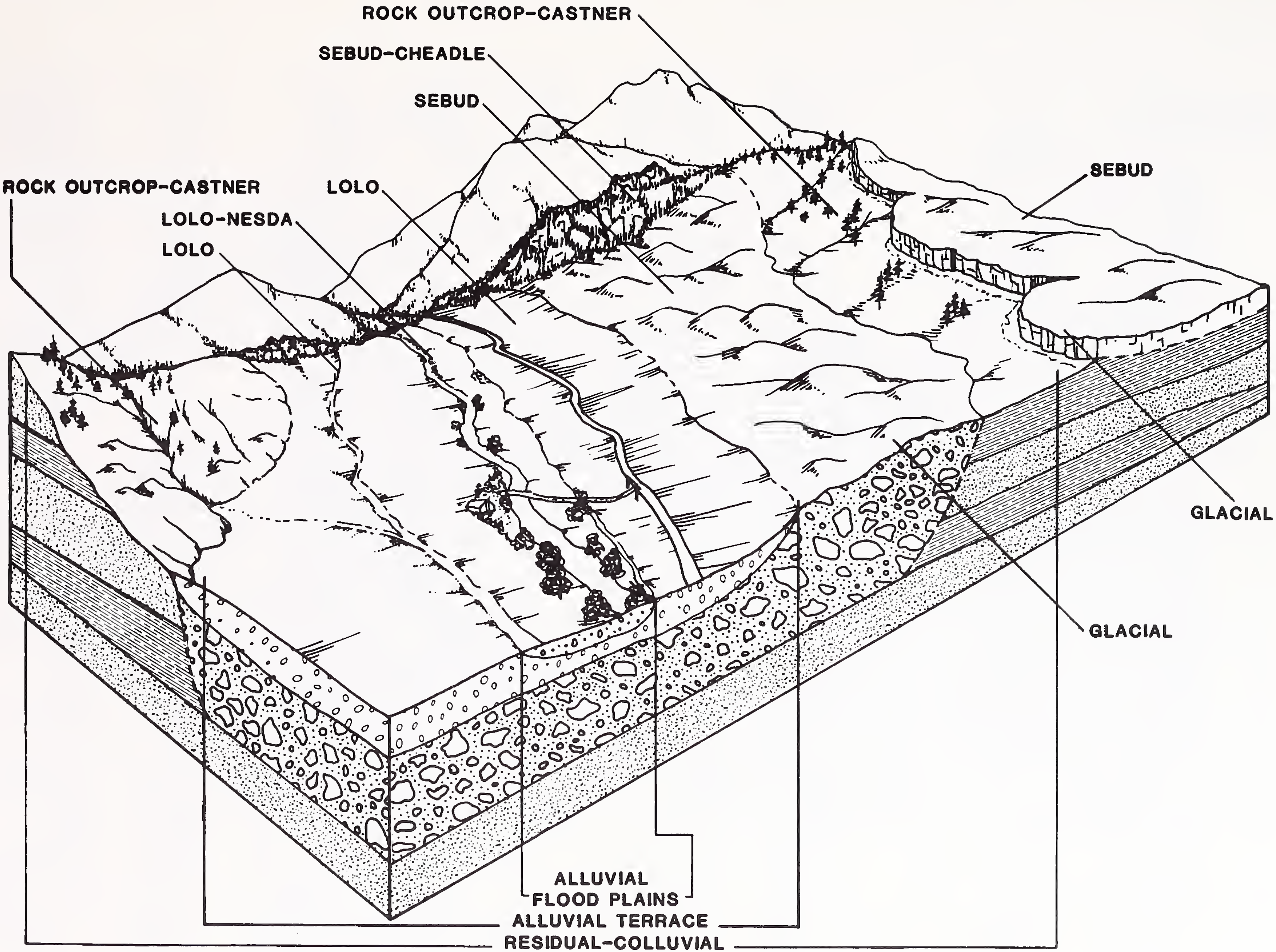


FIGURE III-10
Landscape Diagram of Stillwater Valley, Displaying Soils in Relation to Geology and Topography

2. Soils of the Proposed Permit Area

The soils of the proposed 780-acre permit area are shallow (less than 20 inches) to deep (40 or more inches), have a coarse to fine texture, are moderately acid to moderately alkaline, are low in soluble salts and sodium, and are low to moderate in water- and nutrient-holding capacity.

The soils that would be disturbed at the proposed mine, mill, and tailing areas are generally very stony and mostly coarse-textured. Based on the submitted data, there appear to be no chemical elements in these soils that would pose a hazard to plants, animals, or humans.

D. VEGETATION

1. Study Area Description

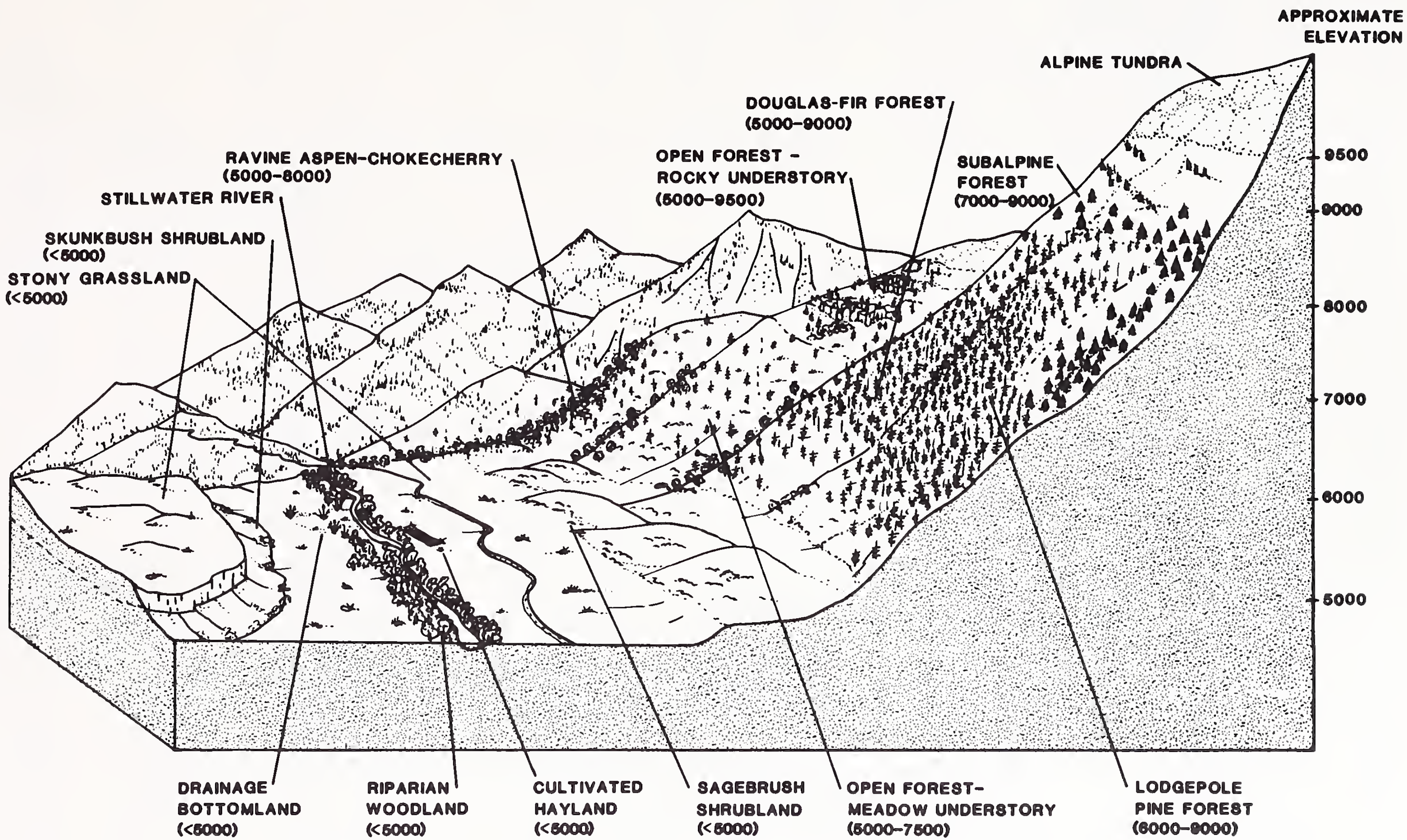
The Anaconda vegetation study area encompasses about 24,547 acres along the Stillwater River. The highest point of the area, 9,050 feet, lies in the southeast portion. The lowest point, 4,690 feet, lies along the Stillwater River in the northeast portion.

Eleven distinct vegetation types, as well as three disturbed types and water occur in the study area. Brief descriptions of the eleven vegetation types are given below. (See also table III-1 and fig. III-11.) Five of these and two of the disturbed types (areas not covered with native vegetation) occur in the area proposed for disturbance.

(1) Stony Grassland. This type occurs on level to rolling foothills and slopes at elevations ranging from the valley floor at 4,756 feet to about 5,248 feet. This type is dominated by perennial forbs and grasses, with the remaining vegetation consisting of nonflowering plants. Among the forbs, silvery lupine (*Lupinus argenteus*), fringed sagewort (*Artemisia frigida*), blazing star (*Liatris punctata*), and Hoods phlox (*Phlox hoodii*) are the most abundant. Idaho fescue (*Festuca idahoensis*) is the most abundant grass; however, needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), little bluestem (*Schizachyrium scoparium*), Western wheatgrass (*Agropyron smithii*), and bluegrass (*Poa* spp.) are common. Additionally, rock salaginella (*Salaginella densa*), sun sedge (*Carex heliophila*), and lichens are common.

(2) Sagebrush Shrubland. This type is found on north- and east-facing slopes, where winds commonly deposit snow on the leeward side of ridges and knolls. This type occurs at low elevations--about 4,920 feet on nearly level to relatively steep slopes.

Big sagebrush (*Artemisia tridentata*) is the dominant species within this vegetative type. Important grass and grasslike species that characterize this type include bluegrass, Japanese brome (*Bromus japonicus*), needleleaf sedge (*Carex stenophylla*), and sun sedge.



<u>FIGURE III-11</u>--Vegetation Types in Anaconda Stillwater Project Area

TABLE III-1

Vegetation Types that Occur in the Anaconda Study Area

Vegetation Type	Study Area Acres	Study Area Percent of Total	Area Proposed For Disturbance Acres	Area Proposed For Disturbance Percent of Total
Stony Grassland	6,158	25.0	131	79.3
Sagebrush Shrubland	172	0.7	10	5.9
Skunkbush Shrubland	995	4.1	0	0.0
Drainage Bottomland	320	1.3	< 1	0.4
Riparian Woodland	1,258	5.0	0	0.0
Ravine Aspen-Chokecherry	552	2.3	0	0.0
Open Forest-Meadow Understory	3,022	12.3	12	7.2
Open Forest-Rocky Understory	5,630	23.3	2	1.3
Douglas Fir Forest	2,276	9.6	0	0.0
Lodgepole Pine Forest	1,832	7.5	0	0.0
Subalpine Forest	427	1.8	0	0.0
Revegetated Chrome Tailing	75	0.2	0	0.0
Cultivated Hayland	1,488	5.9	< 1	0.3
Disturbed[1]	332	1.0	9	5.6
Water	10	0.1	0	0.0
TOTAL	24,547	100.0	165	100.0

[1] Disturbed areas include abandoned mine areas, roads, and current disturbances related to Anaconda's exploratory operations.

Important forb species include silvery lupine and silky lupine (Lupinus sericeus).

(3) Skunkbush Shrubland. This vegetative type is characterized by skunkbush sumac (Rhus trilobata) on south- and west-facing slopes. This type occurs on steep to very steep slopes at low elevations--4,920 feet. Dominant grass species include bluebunch wheatgrass (Agropyron spicatum) and needle-and-thread, with minor amounts of blue grama, cheatgrass (Bromus tectorum), and bluegrass. Important forbs are fringed sagewort, Hoods phlox, and slimflower scurfpea (Psoralea tenuiflora). Lichens are also a significant and frequent ground cover.

(4) Drainage Bottomland. This is a wet-meadow type generally found in swales or low-lying areas and dominated by wetland grasses and forbs. This is a complex unit that has been strongly influenced by grazing, irrigation, and other disturbances commonly resulting in a weedy species composition. This type occurs on level terrain at elevations of 4,756 to 5,018 feet.

Important grass species include bluegrass, needle-and-thread, and meadow fescue (Festuca pratensis). Sedge and rush species include beaked sedge (Carex rostrata), tule bulrush (Scirpus acutus), and spikesedge (Eleocharis macrostachya). Abundant forbs include common dandelion (Taraxacum officinale), red clover (Trifolium pratense), field mint (Mentha arvensis), and fringed sagewort.

(5) Riparian Woodland. This vegetative type occurs on the banks, level bottoms, and floodplains along the major streams and rivers in the study area and usually occurs at elevations between 4,756 and 5,248 feet. It is characterized by strips of deciduous hardwoods along the East and West Forks of the Stillwater River, as well as along portions of Little Rocky Creek.

The Riparian Woodland type is dominated by a tree overstory comprised primarily of black cottonwood (Populus trichocarpa) and occasionally balsam popular (Populus balsamifera); quaking aspen (Populus tremuloides) was found in some sample areas. Other important tall woody species include willows (Salix spp.), alders (Alnus spp.), birch (Betula spp.), common chokecherry (Prunus virginiana), and red-osier dogwood (Cornus stolonifera).

Important grass species are bluegrass and redtop (Agrostis alba); shrubs and forbs include whortleleaf snowberry (Symphoricarpos oreophilus), woods rose (Rosa woodsii), and cutleaf coneflower (Rudbeckia laciniata).

(6) Ravine Aspen-Chokecherry. This type is characterized by patches of quaking aspen and common chokecherry, which occur on mountain slopes near seeps and springs or in areas where ground water is near the surface. This vegetative type differs from the streamside Riparian Woodland type in that it lacks surface water and occurs on steeper mountain slopes between 4,920 and 8,200 feet.

The tree overstory is dominated by quaking aspen, with common chokecherry, birch, and Rocky Mountain maple (Acer glabrum) dominant in the understory. Frequently occurring shrub species include whortleleaf snowberry, mountain ninebark (Physocarpus monogynus), and horizontal juniper (Juniperus horizontalis). Forb species include cutleaf coneflower, cow parsnip (Heracleum sphondylium), meadow aster (Aster conspicuus), and wartberry fairybells (Disporum trachycarpum). Grass species are relatively unimportant in this vegetative type.

(7) Open Forest-Meadow Understory. This is an intermediate type between forest and grassland types. It occurs on level areas to steep slopes, on all aspects, and at mid-elevations between 5,248 and 7,616 feet.

Trees in this type consist of Douglas-fir (Pseudotsuga menziesii) and limber pine (Pinus flexilis). The trees are scattered and separated by areas of forbs, grasses, and shrubs. Forb species are abundant and include arrowleaf balsamroot (Balsamorhiza sagittata), spreading dogbane (Apocynum androsaemifolium), field chickweed (Cerastium arvense), silvery lupine, and fringed sagewort. Abundant grass species are bluebunch wheatgrass, bluegrass, Idaho fescue, and needle-and-thread. Important shrubs include mountain ninebark, horizontal juniper, and skunkbush sumac.

(8) Open Forest-Rocky Understory. This is an intermediate type between forest vegetation types and bare rock outcrop, cliffs, and talus slopes. This type occurs on moderate to very steep slopes at elevations between 4,838 and 8,856 feet. Scattered Douglas-fir and limber pine trees are the dominant species, although ponderosa pine (Pinus ponderosa) and lodgepole pine (Pinus contorta) occasionally occur. Some shrubs found in significant amounts in this type include common juniper (Juniperus communis), horizontal juniper, and mountain ninebark. Forb and grass species contribute relatively minor amounts to the vegetative cover; lichens are by far the most dominant ground cover.

(9) Douglas-fir Forest. This type is located at elevations between 5,002 and 8,856 feet on level areas to steep slopes. Douglas-fir is the dominant species. The only important shrub is common juniper. Forb species contribute a small amount to the vegetative cover; species include spreading dogbane, loose-flowered milkvetch (Astragalus tenellus), and white spiraea (Spiraea betulifolia). Grasses and sedges are present in very small, often trace amounts.

(10) Lodgepole Pine Forest. In the study area, the Lodgepole Pine Forest type is frequently located on the bottom and sides of broad, U-shaped glaciated valleys from 6,232 up to 8,856 feet. Slopes are nearly level to steep. Lodgepole pine is the primary overstory species; however, Douglas-fir exists in the more mature, open stands. Lodgepole pine is often considered to be a seral (temporary) species replaced gradually by Douglas-fir, forming a Douglas-fir Forest vegetation type at the climax stage (Pfister et al., 1977).

Limber pine also occurs in low densities within this vegetative type. Dense stands of lodgepole pine frequently have very little or no understory vegetation, and the ground is covered with a dense mat of pine needles. The more mature open stands contain an understory of such shrubs as common juniper, mountain ninebark, woods rose, and kinnikinnick (Arctostaphylos uva-ursi). The most frequent and abundant understory plants occurring at all sample sites are lichens and mosses. Grasses and sedges occur in insignificant amounts.

(11) Subalpine Forest. This vegetative type is highly variable. It is located on mountain tops and slopes, glaciated valley sides, and basins between 7,052 and 8,856 feet in elevation.

The characteristic tree overstory of this type consists of a mixed timber stand of subalpine fir (Abies lasiocarpa), Engelmann spruce (Picea engelmannii), limber pine, Douglas-fir, and lodgepole pine. Three phases of the Subalpine Forest type exist, each dependent upon available soil moisture and each differentiated by understory species composition. The moist phase understory is dominated by huckleberry (Vaccinium scoparium and Vaccinium globulare). The intermediate moisture phase is dominated by huckleberry and other forb species. The dry phase is dominated by common juniper, white spiraea, and lichens.

2. Range Condition and Stocking Rate

Average range condition and stocking rate were calculated for the study area and the proposed permit area using all vegetation types, except for the Open Forest-Rocky Understory, the Douglas-fir, the Lodgepole Pine, the Subalpine Forest, and the disturbed types. The average range condition for the portion of the study area considered (about 12,500 acres) is "low-good", with the vegetation communities at about 58 percent of their climax. The average stocking rate for this area is about 5,452 cow-calf units for a 1-month grazing period, or about 606 cow-calf units for a 9-month period. Assuming 75 percent of climax vegetation, the potential stocking rate for the study area is about 6,488 cow-calf units for a 1-month period, or about 721 cow-calf units for a 9-month period.

The average range condition for the portion of the proposed permit area considered (about 154 acres) is "low-good", with the vegetation communities at about 51 percent of their climax. The average stocking rate is about 37 cow-calf units for a 1-month grazing period, or about 4 cow-calf units for a 9-month period. Assuming 75 percent of climax vegetation, the potential stocking rate for the proposed permit area is about 59 cow-calf units for a 1-month period, or about 6.5 cow-calf units for a 9-month period.

3. National Forest Timber Resources

The part of the national forest that would be affected by mining is on steep, rocky, forested slopes. The principal tree species are lodgepole pine, Douglas-fir, and limber pine. The harsh site and

overstocked conditions have limited growth potential. The majority of trees are pole-sized or poorly formed, small sawtimber. All stands are of very low commercial value due to the poor quality of the timber and the difficulty ground conditions would pose to a commerical timber operation.

Historically, no significant quantity of timber has been harvested from the area. Some pole or prop material may have been cut from the slope during previous mineral activities, but only small quantities incidental to development. There is no plan at this time for harvest of this area and it is highly unlikely the timber will ever be of commercial value. The principal values of the tree vegetation are for watershed protection and scenery enhancement.

E. AQUATIC ECOLOGY

Five streams lie near the proposed Anaconda Stillwater project: Stillwater River, West Fork of the Stillwater River, Verdigris Creek, Mountain View Creek, and Nye Creek. Information on the aquatic ecology of these streams was obtained primarily from two sources. Fisheries data were derived from a Montana Department of Fish, Wildlife and Parks (MDFWP) report that summarized results of a 1981 electrofishing effort on the Stillwater River (Toennis, 1981). Aquatic invertebrate and periphyton information were obtained from a 1980-81 study prepared for Anaconda (CDM, 1981). During that study, ten aquatic sampling stations were established within the project area, including six stations on the Stillwater River, and one each on the West Fork of the Stillwater, Verdigris Creek, Mountain View Creek, and Nye Creek (fig. III-12). Supplemental information was collected from the Montana Department of Health and Environmental Sciences, the Montana Department of Fish, Wildlife and Parks, the U.S. Forest Service, and the U.S. Fish and Wildlife Service.

1. Aquatic Habitat

The quality of aquatic habitats at the ten stations studied by CDM ranged from undisturbed conditions near Station S-1 to habitats affected by wind-blown tailing at Station NC-1 on Nye Creek. The aquatic habitats--including the riparian zone--of all stations located on the Stillwater River and the West Fork of the Stillwater River were in stable condition and exhibited stream habitat conducive to fish and aquatic insect production.

Degraded aquatic habitats were found in the three tributary streams. Verdigris Creek contains elevated concentrations of metals that may result from the stream passing through an area of decomposed rock rich in oxidized metal pyrites. Suitable habitat for fish and aquatic insect production is limited in Mountain View Creek because of chromium ore concentrates and in Nye Creek because of mine tailing.

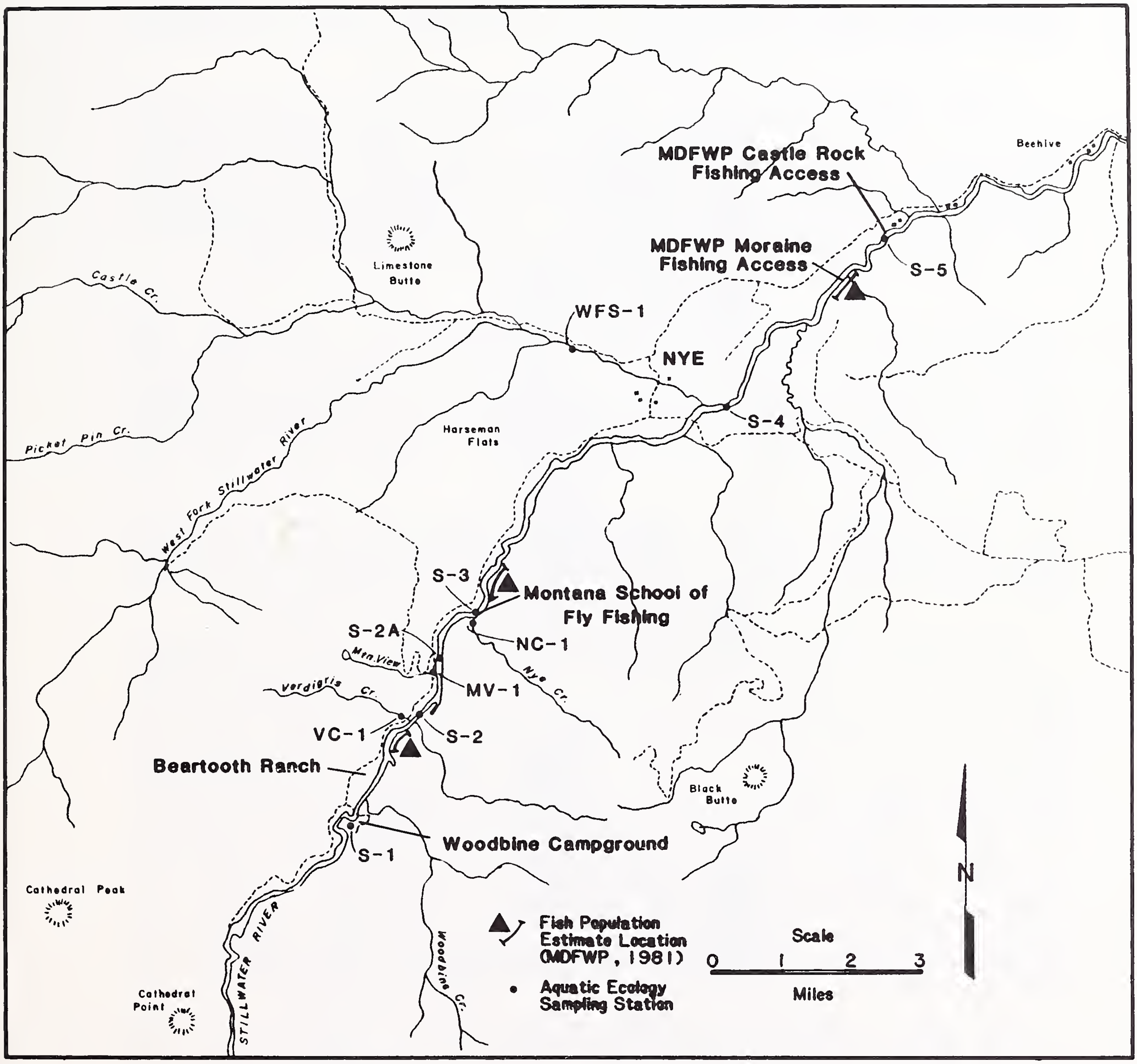


FIGURE III-12--Aquatic Sampling Stations Established in the Project Area

2. Fisheries

The Stillwater River is considered by MDFWP to have statewide fishery value, while the West Fork of the Stillwater River is considered to be of important regional value.

Eight species of fish have been collected from the Stillwater River including rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), brook trout (Salvelinus fontinalis), mountain whitefish (Prosopium williamsoni), longnose sucker (Catostomus catostomus), mountain sucker (Catostomus platyrhynchus), and longnose dace (Rhinichthys cataractae). Cutthroat trout (Salmo clarki) have also been captured in the Stillwater River near the Castle Rocks fishing access point (Stewart, 1977).

Rainbow trout, brown trout, and brook trout have also been collected in the West Fork of the Stillwater River, Nye Creek, and Mountain View Creek (Stewart, 1977). In addition, mountain whitefish have been found in the West Fork of the Stillwater River, and longnose sucker and longnose dace in Mountain View Creek. Electrofishing surveys have not been conducted on Verdigris Creek; however, no fish were observed during the field survey in 1980-81.

Electrofishing studies emphasized obtaining data for four game fish: brown trout, rainbow trout, mountain whitefish and brook trout. (See fig. III-13.) These four species make up the bulk of the fish biomass in the upper Stillwater, and are highly desired by anglers.

The numbers of fish captured tended to vary in response to spawning activities and influx of migrants. Large numbers of rainbow trout migrate into the study area for spawning. These individuals tend to move from the area by June or early July, leaving only resident rainbows. The situation is similar during fall when brown trout and whitefish numbers increase during spawning. Brown trout and whitefish numbers are high, while rainbow numbers are low, reflecting the resident population. (Brook trout numbers remain relatively constant, indicating a stable resident population and a lack of pronounced migration patterns.) Sampling within the Beartooth Ranch area resulted in resident population estimates of approximately 310 rainbow, 65 brown and 105 brook trout per 1,000 feet of river. Brown trout were numerous at downstream sampling points and reached a density of approximately 370 per 1,000 feet at the Moraine Fishing Access point during fall.

Two major spawning areas were located between Stations S-1 and S-2a, the first approximately 1,900 ft (600 m) downstream from the Beartooth Ranch, and the second 260 feet (80 m) below the JLX Ranch. (See fig. III-12.) Rainbow trout spawning activity was observed at both sites during spring surveys. Because of the scarcity of spawning sites, these two areas may represent critical habitat for the fish populations of the Stillwater River. Tagging data suggest that trout from the Yellowstone and lower Stillwater Rivers also spawn in these areas.

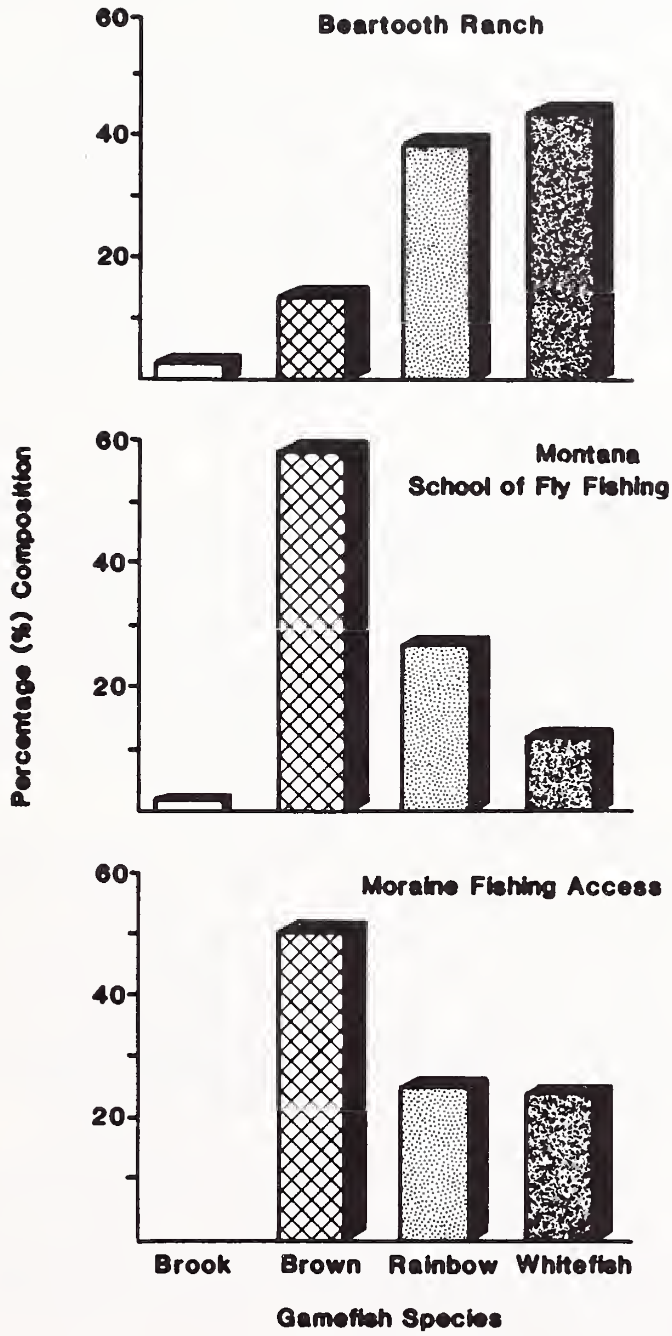


FIGURE III-13--Quantity of Various Game Fish Species as Percentage of Total Captured

The river environment downstream from Beehive is suitable for year-round presence of big fish; however, adequate sites for reproduction are not available. The gravel substrate, side channels, and flows of the Upper Stillwater River in the study area provide good spawning and rearing habitat for all game fish.

Based on previous studies by the MDFWP (Stewart, 1977) and analysis of 1981 electrofishing data, the trout and whitefish populations present in the Stillwater River and West Fork of the Stillwater River appear to be self-sustaining and in stable condition. Although catchable hatchery rainbow trout have been stocked in the Stillwater River near the Buffalo Jump fishing access, the total contribution of these fish to the fishery is probably negligible. Compared to the Stillwater River and the West Fork of the Stillwater River, the three tributary streams (Verdigris Creek, Mountain View Creek, and Nye Creek) contain limited fisheries.

3. Aquatic Invertebrates

The aquatic invertebrate community within streams of the Anaconda Stillwater Project area was found, for the most part, to be highly diverse and abundant. Densities of aquatic invertebrates ranged from 3,905 organisms per square meter at Station S-2 to 29,290 organisms per square meter at Station S-4. The density of organisms in the Stillwater River increased in a downstream direction. Between 17 and 46 different kinds of aquatic insects were collected at each of the stations located on the Stillwater River and West Fork of the Stillwater River.

Organisms collected included many that are sensitive to environmental degradation (e.g. the mayflies Rithrogena, Epeorus, Ephemerella, Heptagenia, and Pseudocloen; the stoneflies Chloroperlidae and Nemouridae; and the caddisflies Rhyacophila and Arctopsyche). Their presence indicated good water quality and aquatic habitat conditions. The aquatic insect communities were also functionally diverse (Cummins, 1978) with representative algae scrapers (Baetis, Epeorus), predators (Isoperla and Rhyacophila), collectors (Ephemerella) and filter feeders (Arctopsyche and Simulium) found throughout the study area.

The diversity of aquatic invertebrates found within the tributary streams was lower than in the Stillwater River. Mountain View Creek was the most diverse of the three tributary streams with 21 invertebrate organisms followed by Verdigris Creek with seven and Nye Creek with six. The paucity of aquatic insect types in these streams was probably directly related to the quality of aquatic habitats.

4. Periphyton

Periphyton is a group of a variety of organisms, including bacteria, protozoa, and algae, that are attached to rocks, plants, or other stream substrates. Data collected during three sampling periods (spring, summer, and fall) in the Stillwater River and the West Fork of the Stillwater River indicate a diverse periphyton community.

Diversity indices ranged from approximately 1.2 at S-1 to 3.5 at S-5. The diversity index tends to be high when there is a large number of species and when individuals are evenly distributed. Within the study area, diversity was highest in downstream reaches of the Stillwater River and at the sampling station on the West Fork of Stillwater. The dominant taxonomic groups of periphyton found included the Bacillarophyta (diatoms) and Chrysophyta (yellow-green algae). These two groups made up from 13 to 93 percent (diatoms) and from 0 to 81 percent (yellow-green algae) of the total periphyton collected during the three sampling periods. Cyanophyta (blue-green algae) and Chlorophyta (green algae) were important components during the summer samplings: blue-green species made up as much as 65 percent, and greens as much as 52 percent, of the total number of organisms present at any one station. Green algae were also important during the fall sampling, composing as high as 56 percent of the total numbers per station. Other taxonomic groups such as Euglenophyta (euglenoids) and Pyrrhophyta (dinoflagellates) were only minor components of the samples.

Several of the periphyton species collected are indicators of good water quality. The diatom Achnanthes minutissima was one of the most abundant organisms sampled and is an indicator of high dissolved oxygen concentrations. The yellow-green algae Hydrurus foetidus was also abundant and is characteristic of streams having good water quality, high velocities, and cool temperatures. The dominance of diatoms at most stations in the Stillwater River and West Fork of the Stillwater River is characteristic of aquatic ecosystems that are largely undisturbed.

F. WILDLIFE

1. Data Base

Wildlife populations were sampled by three agencies for this project: consultants working for the Anaconda Minerals Company conducted a baseline inventory during 1980-81; the Montana Department of Fish, Wildlife and Parks (MFWP) marked and radio-collared big game species in the area; and the Forest Service submitted a biological assessment of potential impacts on threatened and endangered species. These reports are on file with Department of State Lands (DSL), and except for some maps included in the Forest Service report, are open to public review. (Segments of the threatened and endangered species report cannot be released because of the sensitivity of these species to human activity.) This section and the following section (Threatened and Endangered Speces), as well as these two sections in chapter IV, were derived primarily from the above reports.

2. General Description of the Area

In the studies done for the project the wildlife study area and the proposed permit area were found to support diverse animal populations. (The wildlife study area encompassed the permit area plus a two-mile-wide area surrounding it.) During the sampling period, seven reptiles

and amphibians, 143 birds, and 35 mammals were recorded. Large mammals included mule and white-tailed deer, bighorn sheep, elk, black bear, moose, mountain lion, and mountain goat. Representatives of almost every big game species present in the State were found within or near the proposed mine and mill complexes. In addition, populations of blue and ruffed grouse were present.

Physical characteristics (such as elevation, slope, aspect, wind, and climate) and a wide variety of vegetation communities work together to provide suitable habitat for individual species. In the study area the vegetation varies from conifer forests to deciduous river bottom to grasslands, and these make up a variety of habitat types. (See fig. III-14.) Several important winter ranges were also found within the study area's boundaries.

Vegetative community types are described in detail in the vegetation section. Table III-2 presents a cross listing of vegetative communities and wildlife habitat types. The vegetation section summarizes the major forms and species found in each type.

3. Big Game Species

a. Mule deer

Mule deer were by far the most common big game animal in the study area, particularly during the winter. The population of mule deer was estimated to be 3,924 during the March 1981 survey. Densities varied by survey unit from a low of 10 to a high of 72 per square mile. (The study area was divided into 8 units, each a different size and corresponding to a different habitat.) Table III-3 presents estimates for each unit.

Total numbers of mule deer in the area may be affected by winter conditions. The 1980-81 winter was relatively mild. Some deer may not have moved into the area because they found adequate food and shelter elsewhere. In a hard winter, more deer could be expected on the area.

The mule deer population was found to be increasing in size. Production rates were high during fall 1981 with 71 fawns per 100 does. Few fawns died during the winter season (Simmons et al., 1981). As a result, a large percentage of the deer were yearling during 1981. Adult males do not fare as well--of the individuals captured and marked, none were older than 2½ years. This may result from an inability to capture older males, unusually high death rates of older males, or emigration.

During counts, mule deer were not evenly distributed throughout the study area. Instead, four concentration areas were found.

(1) Beartooth--the Beartooth area stretches from Woodbine Campground north to about one mile north of the mine headquarters; the Stillwater River generally runs through the center of the area.

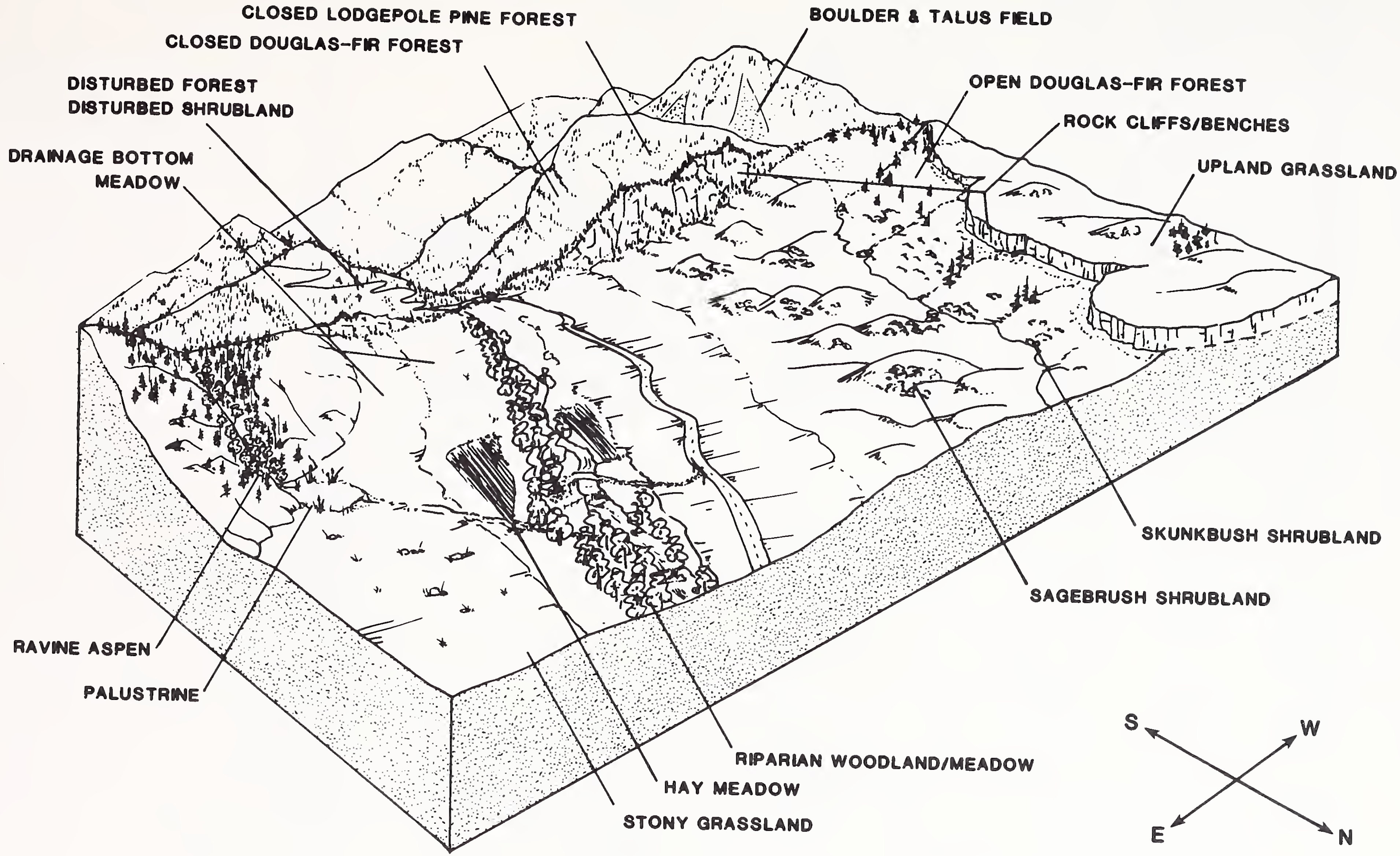


FIGURE III-14--Principal Habitat Types

TABLE III-2--Comparison of Vegetative Community and Wildlife Habitat Types

Habitat Type	Vegetative Types
Boulder and Talus Field	Open Forest-Rocky Understory
Closed Douglas-fir Forest	Douglas-fir Forest
Closed Douglas-fir/Lodgepole Pine Forest	Lodgepole Pine Forest
Closed Lodgepole Pine Forest	Lodgepole Pine Forest
Hay Meadow	Cultivated Hayland
Disturbed Forest	Open Forest-Meadow Understory Lodgepole Pine Forest
Disturbed Grassland	Revegetated Chrome Tailing
Disturbed Meadow	Open Forest-Meadow Understory
Disturbed Shrubland	Revegetated Chrome Tailing
Drainage Bottom Meadow	Drainge Bottomland
Mosaics[a]	--
Open Douglas-fir Forest	Open Forest-Meadow Understory Open Forest-Rocky Understory
Palustrine	--
Ravine Aspen	Ravine Aspen-Chokecherry
Riparian Woodland/Meadow	Riparian Woodland
Rock Cliffs/Benches	Douglas-fir Forest, Open Forest-Rocky Understory
Sagebrush Shrubland	Sagebrush Shrubland
Skunkbush Shrubland	Skunkbush Shrubland
Stony Grassland	Stony Grassland
Upland Grassland	Stony Grassland

[a]Mosaics represent ecotones and vegetation phases of various wildlife habitat types, and none of the types developed by other investigators are directly comparable.

(2) Keogh--The Keogh area is centered around the Buffalo jump (Horseman Flats) and is bound by the Stillwater River on the south and east.

(3) Hertzler--The Hertzler area lies in Hertzler Valley and extends westward through Robinson Draw. The proposed mill/tailing area covers the eastern edge of the winter-spring range in this concentration area. Additional work is being conducted on this deer herd and may be available for the final EIS.

(4) Stillwater--The Stillwater area is situated east of the Stillwater River in a triangle bounded by the communities of Dean, Beehive, and Nye.

TABLE III-3--Upper Stillwater Mule Deer Population Estimates and Densities by Helicopter Survey Unit, Mid-March 1981

Survey Unit	Population Estimate	Area Surveyed (square meters)	Density (deer/square mile)
1	1,157	16	72
2	443	15	30
3	71	7	10
4	292	15	19
5	328	6	55
6	490	36	14
7	822	18	46
8	321	9	36
Total	3,924	122	32

Lovaas (1950) found both migratory and resident deer populations in the study area. In the studies done for the Anaconda project these findings were corroborated. Three does captured in the Beartooth area moved south along the Stillwater River and down to the Slough Creek Campground (within Yellowstone National Park). In another instance, one male marked at the north end of the study area was located south of Cooke City in July; he returned to the original capture site by the end of October. This individual covered an area encompassing 101 square miles. Most migratory mule deer were found to have returned to the study area by mid-December.

Habitat use by deer was separated into spring/summer and fall/winter sightings. Two types of data collection (vehicle/pedestrian and aerial surveys) were used with different results. In spring and summer, observations during vehicle and pedestrian transects found 40.8 percent of the mule deer sightings in stony grassland habitats and 29.9 percent within the hay meadow type. Aerial surveys differed considerably: upland grassland (25.6 percent) and sagebrush shrubland (24.5 percent) were most frequently used. Aerial results indicated a lower use in stony grasslands (14.5 percent) and higher use of skunkbush shrublands (16.7 percent), and open Douglas-fir forest (13.2 percent).

The results of ground surveys during fall and winter were similar. Use of stony grassland type was essentially the same (40.7 percent), although sightings in hay meadows decreased somewhat (20.7 percent). Use of open Douglas-fir types increased (12.4 percent). Results of aerial survey were again different from ground surveys. The highest use documented by this technique was in open Douglas-fir forest (31.9 percent). Sagebrush shrubland was used 21 percent of the time, upland grassland 19.4 percent of the time, and stony grassland habitats 12.8 percent of time.

Differences in results between aerial and ground surveys were probably due to observer bias, differences in observability due to type of technique used, and observability differences between habitats.

b. White-tailed deer

During the 1800s white-tailed deer were described as "fairly abundant" in the Beartooth Mountains; by 1910 they had dwindled to "very scarce" (Cooney, 1936). The Montana Department of Fish and Game transplanted white-tails to the Beartooth Mountains from 1945-1947. Approximately 20 deer were released near the Beartooth Ranch during two years (1945-1946). The total population was estimated at 100 in 1949 (Stoneberg, 1977). A population estimate using marked deer was conducted on March 27, 1982, by Montana Department of Fish, Wildlife and Parks personnel. The department estimated that 251 animals were within the area, a density of 19 white-tailed deer per square mile.

Within the study area white-tailed deer range along the Stillwater River south to Nye Creek; along the West Fork of the Stillwater River to the middle of Horseman Flats; and along the lower reaches of Little

Rocky and and Fishtail Creeks. They have been observed as far north as Meyer's Creek and as far south as the vicinity of Woodbine Campground. The Department of Fish, Wildlife and Parks study indicates that white-tails are very mobile during the winter season. Some individuals were observed several miles from their original capture sites. Current information indicates an important travel corridor between Nye junction and the Nye road.

Fawn production rates were excellent during 1981. Fall counts indicated 125 fawns per 100 does. These rates were the highest observed in several years.

Habitat use, as determined by aerial surveys, was concentrated in three habitats. In spring and summer white-tailed deer used stony grassland habitat 63.1 percent of the time, hay meadow 23.1 percent of the time, and riparian woodland meadow, 4.6 percent of the time. In fall and winter the deer used stony grassland 15 percent, hay meadow 37.5 percent, and riparian meadow 31.3 percent of the time. Riparian habitat use was probably underestimated because of the low visability within this habitat.

c. Bighorn sheep

The bighorn sheep population in the upper Stillwater River Valley has been studied since 1971. In this study almost daily observations were recorded from December to May until 1976. Study intensity was lower afterwards. The study found that the size of the herd peaked during the 1977-78 study period, then declined, but has since remained above earlier years. Table III-4 presents population estimates for the last ten years. The population has been relatively stable during the last few years.

TABLE III-4--Size of the Stillwater Bighorn Sheep Population, Post-Hunting Season, 1971-72 to 1980-81

Year	Rams	Ewes	Lambs	Total
1971-72	4	18	11	33
1972-73	8	22	14	44
1973-74	7	25	15	47
1974-75	7	28	11	46
1975-76	7	28	9	44
1976-77	11	27	12	50
1977-78	13	31	16	60
1978-79	12	25	15	52
1979-80	17	26	8	51
1980-81	14	27	11	52

Bighorn sheep were seen in the study area throughout the year but were much more common during fall and winter months. The south end of the study area, near Woodbine Campground, was defined as the primary winter range for the herd. The major concentrations occurred between the Mouat Mine site and the Woodbine Trailhead. The winter range was found to make up slightly less than 3.1 square miles and be used by all of the sheep in the bighorn population at some time during the winter months. Several peripheral winter ranges occur nearby. These areas are used by a limited number of individuals.

Some bighorns arrive on the winter range by mid-October (all have arrived by mid-November) so that rut activities occur here. Important areas during this time are the rocky cliff south of Mouat Mine, the vicinity of the Woodbine Trailhead, and the Stillwater Canyon north of Verdigris Creek. After the rut the mature rams segregate from ewes, lambs, and young rams and remain along mine roads in the vicinity of Verdigris Creek. They stay separate except for a short time in late March and April.

Ewes leave the winter range beginning in early June and move to lambing areas, then to summer ranges. For the most part, ewes move up the Stillwater for lambing and summer range. Rams begin movement to summer ranges between early and mid-June. They move through the lambing areas by Flood Creek, then east to Columbine Lake area until they move across East Fork of the Boulder River. Winter/summer ranges and travel lanes between areas tend to be used year after year and the pattern of use is apparently passed on between generations. The way winter range is used, however, may be changing. Home range size for four ewes, presented in table III-5, has increased greatly within the last several years. Observations indicate that ewes are using less favorable forage areas with higher cover value as opposed to open bunchgrass types with good food value and no cover.

The number of lambs born each year has averaged about 12 since 1971. The death rate for the first year of life has averaged 59 percent. The death rate for ewes aged 2 to 4 has averaged 12 percent, 27 percent for the age group 5 to 9. Few ewes studied lived past 10 years.

Death rates for rams has been controlled by hunting pressure. In the past, no rams lived past 5 years and most have been taken at 3 years. Since a quota system has been implemented, two rams have lived to be over eight years old.

The Stillwater bighorns are apparently an inbred population. Inbreeding has resulted because (1) the population is essentially isolated, (2) the herd has remained small, and (3) earlier hunting pressure has reduced the number of effective males. Such a high rate of inbreeding has resulted in a population accustomed to a narrow set of environmental conditions (MFWP, 1982).

TABLE III-5--Home Range Sizes for Four Stillwater Bighorn Ewes During Winters 1976-77 through 1980-81

Ewe		1976-77 (mild)[1]	1977-78 (moderate)[1]	1978-79 (severe)[1]	1979-80 (mild)[1]	1980-81 (mild)[1]
01	Home Range Size ($miles^2$)	.02	.28	.16	.64	.20
	Sample Size	4	8	15	14	7
02	Home Range Size ($miles^2$)	-	.01	.17	.89	.64
	Sample Size	-	5	16	16	21
59	Home Range Size ($miles^2$)	.32	.19	.90	.25	.13
	Sample Size	9	8	14	15	9
66	Home Range Size ($miles^2$)	.20	.11	.16	1.09	1.56
	Sample Size	8	8	16	14	24

[1] General winter weather conditions.

d. Elk

A small herd of elk became established in the study area in the early 1950s. The population has been stable to increasing ever since; the highest count was 86 individuals during the 1981 survey.

Elk apparently use summer range outside the wildlife study area. Stoneberg (1977) found summer ranges on the Breakneck Plateau and Placer Basin. Within the study area, three winter range units were described prior to this study. An additional range was found during 1980-81 in the vicinity of the Meyers Creek Ranger Station about 5 miles northwest of the mill/tailing site. The use of this area occurred only during 1980-81 and may indicate a shift in wintering to the north of previously used areas. Another distributional change was noted: the Main Stillwater unit was used only during spring, whereas Horseman Flats received little use at this time.

e. Other large mammals

During the studies done for the project, the remaining large mammals were infrequently seen within the study area and are known only from occasional sightings. Specific information concerning these populations is limited. Nonetheless, following is a short description of each:

(1) Black bear--From five to seven black bears were known to be using southeast-facing slopes between May and June, 1981. Thirteen individuals were identified north and west of the proposed mine/mill complex.

(2) Moose--Little is known about moose in the area. However, it seems likely that moose have decreased since the mid 1950s. Most of the important areas for moose are south of the study area along Fishtail and Fiddler Creek and from Woodbine Campground south to Flood Creek.

(3) Mountain goat--A mountain goat herd was introduced and established south of Woodbine Campground. Only one individual goat was seen in the area during the studies done for the project.

4. Other Raptors

Thirteen raptorial species were observed in the wildlife studies in addition to the peregrine falcon and bald eagle. The most common year-round resident sighted was the golden eagle. Most observations were in stony grasslands and on rocky cliffs. An active nest was located several 100 yards from Anaconda's headquarters. During 1980, a single fledgling was produced. The nest was not active the following year.

The northern harrier, red-tailed hawk, and American kestrel are common summer residents of the study area, while rough-legged hawk, bald eagle and prairie falcon are common during winter. In wildlife studies,

the rough-legged hawk was the most often sighted of the three winter species.

5. Small Mammals

Small and medium-size mammals are important prey for avian and mammalian predators. (They are also pest species.) Eleven species of rodents were trapped; however, 90 percent of the sightings were of the deer mouse, which was captured in all habitats. In addition, several kinds of voles, shrews, the bushy-tailed woodrat, the yellow-pine chipmunk, and the least chipmunk were captured. Table III-6 presents the results of transects for several common species found.

Medium-size mammals included coyote, beaver, muskrat, raccoon, and others. Information on these is restricted to occasional observations; little detailed information is available.

6. Songbirds

Ninety-two species of songbirds were observed during the one-year study period (1980-81). Riparian woodland and open Douglas-fir habitats were found to support the greatest number of species and populations of birds. Stony grasslands contained fewer species (12). Vesper sparrow, western meadowlark, and mourning dove were the most common species in grasslands.

G. THREATENED OR ENDANGERED SPECIES

1. Plant Species

One forb species found in the study area, mountain ladyslipper (Cypripedium montanum), is included on the list of proposed threatened or endangered plant species published by the U.S. Fish and Wildlife Service. Mountain ladyslipper is listed as a category 2 plant, defined as a species "for which information now in the possession of the service indicates the probable appropriateness of listing as endangered or threatened, but for which sufficient information is not presently available to biologically support a proposed rule. Further biological research and field study will usually be necessary to determine the status of the taxa included in this category." This species was not found in the proposed permit area.

2. Animal Species

Two threatened and endangered wildlife species have been known to occur in the study area: the peregrine falcon and the bald eagle.

Peregrine falcons have historically nested within the study area. One cliff complex, approximately one-quarter mile from a major proposed activity site, has been identified as a previous nest site. According to the Forest Service (February 23, 1982, Biological Assessment), the cliff was occupied in 1975-76, with an unconfirmed sighting reported as

TABLE III-6--Observed and Expected Numbers of Common Small Mammals Trapped in the Stillwater Study Area[a]

Habitat	Deer Mouse		Gapper's Red-backed Vole		Yellow-pine Chipmunk		Long-tailed Vole	
	Obs.[b]	Exp.[c]	Obs.[b]	Exp.[c]	Obs.[b]	Exp.[c]	Obs.[b]	Exp.[c]
Boulder & Talus, Rock Cliffs/ Benches	409	118	0	3.7	0	1.6	0	1.7
Forest	625	1,035	49	32.1	14	13.7	11	14.8
Shrubland	222	83	0	2.6	0	1.1	4	1.2
Grassland/Meadow	207	529	0	16.4	2	7.0	0	7.5
Disturbed/Cultivated	404	148	11	4.6	11	2.0	0	2.1
Riparian/Palustrine	166	104	3	3.2	0	1.4	14	1.5
TOTAL	2,033	2,017	63	62.6	27	26.8	29	28.8

[a]To increase sample size, habitat types have been grouped according to the main structural component of each type.
[b]Obs. = Observed number of animals captured per 100 trap-nights.
[c]Exp. = Expected number of animals captured based on proportion of total area occupied by each habitat type and total observed captures.

late as 1980. An immature bird was seen during the 1980-81 survey period, but no active pairs were found. There appears to be additional nesting habitat available downstream from the study area.

The riparian and mosaic habitats close to the cliff and along the length of the river provide excellent hunting habitat for peregrines. Nongame bird transects have documented the presence of preferred prey items.

Bald eagles are present in the study area during fall and early winter (October-December) and winter/spring periods (February-March). This seasonal use appears to occur regularly and is probably associated with open water and a carrion source. Secondary use of the area is for roosting and day-time perching. The number of bald eagles using the area appears to vary; however, Forest Service reports indicate that five individuals have been present north of the study area. MFWP personnel made four eagle observations within one day. The highest known number of birds was seven.

H. CLIMATE

The climate of this region is classified as mountainous continental, since it is located in the mountains far from large bodies of water. This type of climate is characterized by large diurnal and annual temperature ranges and marked differences in precipitation, temperature, and wind patterns over distances of only a few miles.

Thirty-year climatological normals are not available for the immediate area, so the data presented in figure III-15 are from Red Lodge, located 35 miles to southeast (fig. IV-4) of the minesite.

1. Precipitation

Average annual precipitation is 23.2 inches. Over 53 percent of this falls during March through June. About 3.5 inches fall monthly during April, May, and June. However, the greatest amount of effective precipitation--water available for soil formation and erosion--occurs during March and April (figure III-15). The percentage of total precipitation occurring as snow increases with elevation. Below 5,000 feet snow accounts for 15 to 20 percent of the total, while above 9,000 feet it sometimes accounts for as much as 90 percent.

Severe weather in the Stillwater River Valley is uncommon. Heavy thunderstorms occasionally take place in July and August and less frequently in June and September. There is a 20 percent chance a one-inch rainfall will occur in one hour in any given year, whereas a three-inch total in 24 hours could be expected one year in ten (table III-7). Hailstorms also occur infrequently.

TABLE III-7--Size of Largest Storm that can be Expected at the Project Area During Various Lengths of Time

[Source: Miller et al., 1973]

Length of Event	Number of Years Considered					
	2	5	10	25	50	100
	Size of Largest Storm (Inches)					
1 hour	0.7	1.0	1.2	1.5	1.7	1.9
6 hours	1.2	1.6	1.8	2.2	2.4	2.8
24 hours	2.0	2.8	3.0	3.4	3.8	4.2

2. Temperature

The annual average temperature is about 42°F and decreases with elevation. At 10,000 feet it is estimated to be about 30°F. The warmest months are July and August and the coldest is January. At lower elevations the first freezing temperature in autumn normally occurs in mid-September and the last occurs in mid-June. At elevations above 7,500 feet, freezing temperatures may occur at any time.

3. Winds

Prevailing winds are from the southwest to the northwest throughout the year and have an average speed of about 8.6 miles per hour (mph). The higher elevations generally have higher wind velocities. Regardless of elevation, monthly wind velocities are greatest during the winter months and lowest during the summer. The average of the wind velocities measured at the Hertzler Ranch and the minesite is about 11.9 mph during the winter and 6.2 mph during the summer.

I. AIR QUALITY

The air quality in and around the Anaconda Stillwater Project area is excellent. For the monitoring period of August 1980 through July 1981 annual average total suspended particulate (TSP) concentrations ranged from 9.6 ug/m^3 (micrograms per cubic meter) at the Beartooth Ranch site to 17.6 ug/m^3 at the Hertzler Ranch site. These concentrations are well below both Federal and Montana ambient air quality standards (table III-8). Sulfate and lead concentrations measured at the minesite were also low: lead concentrations averaged 0.002 ug/m^3; sulfate concentrations averaged 2.2 ug/m^3.

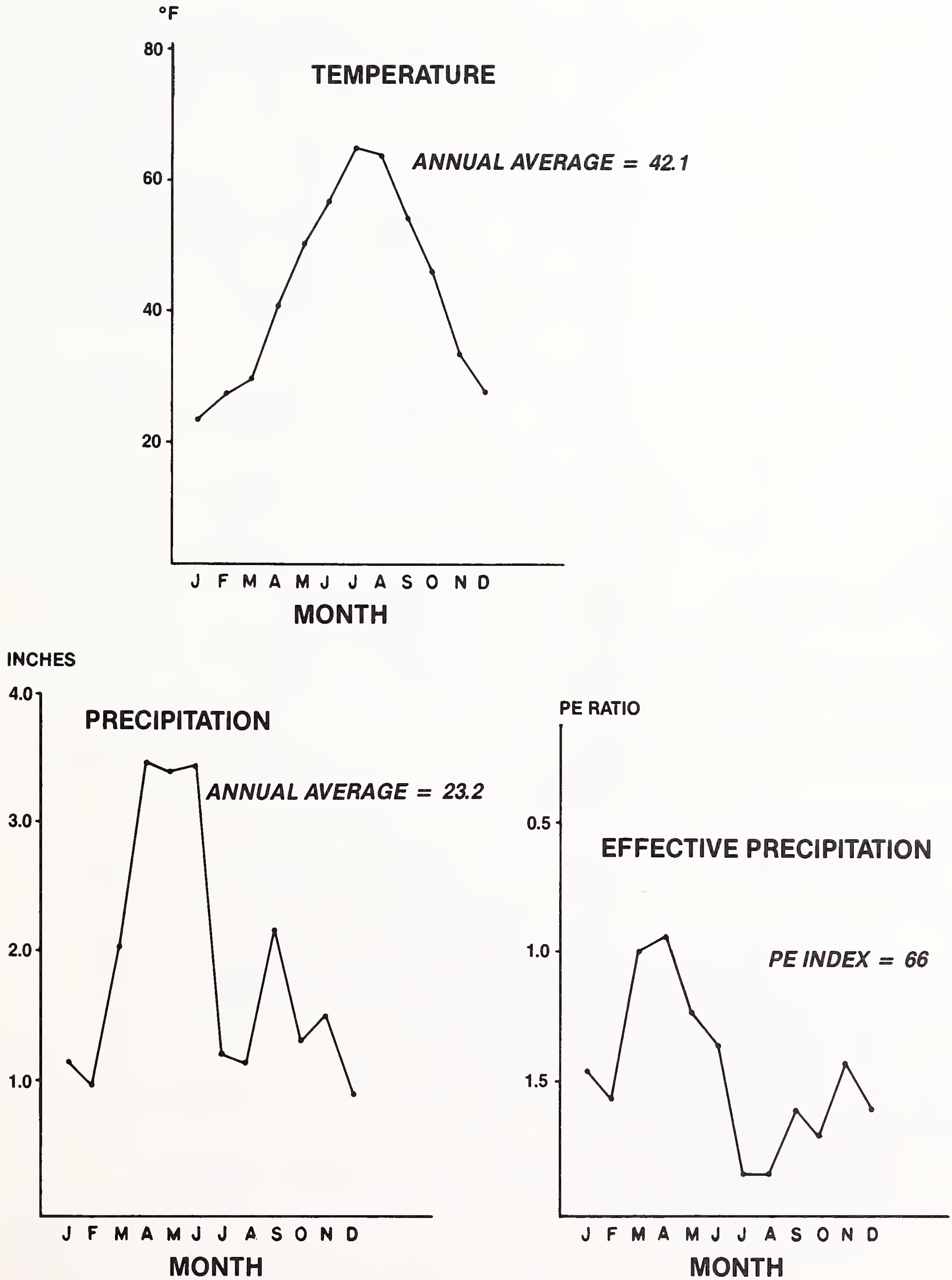


FIGURE III-15
Temperature, Precipitation, and Effective Precipitation at Red Lodge, Montana, 1931-1960

TABLE III-8--Ambient Air Quality Standards (AAQS)

Pollutant	Averaging Time	Montana	Primary[a]	Secondary[b]
Total Suspended Particulate	Annual	75ug/m^3 [b]	75ug/m^3	60ug/m^3
	24 Hour	200ug/m^3 [f]	260ug/m^3	150ug/m^3
Sulfur Dioxide	1 Hour	0.50ppm[e]	---[h]	---
	3 Hour	---	---	0.5ppm
	24 Hour	0.10ppm[d]	0.14ppm	---
	Annual	0.02ppm[f]	0.03ppm[f]	---
Carbon Monoxide	1 Hour	23ppm[4]	35ppm	35ppm
	8 Hour	9ppm[4]	9ppm	9ppm
Lead	90 Days	1.5ug/m^3 [f]	1.5ug/m^3	1.5ug/m^3
Nitrogen Dixoide	1 Hour	0.30ppm[d]		
	Annual	0.05ppm[f]	0.05ppm[f]	0.05ppm[f]
Settled Particulate	30 Days	10g/m^2 [f]	---	---
Nonmethane Hydrocarbons[g]	3 Hour (6-9 a.m.)	---	0.24ppm	0.24ppm
Photochemical Oxidants (ozone)	1 Hour	0.10ppm[d]	0.12ppm	0.12ppm

[a]Federal ambient air quality standards with averaging time less than 1 year are not to be exceeded more than once per year.

[b]Arithmetic average; not to be exceeded.

[c]Geometric mean; not to be exceeded.

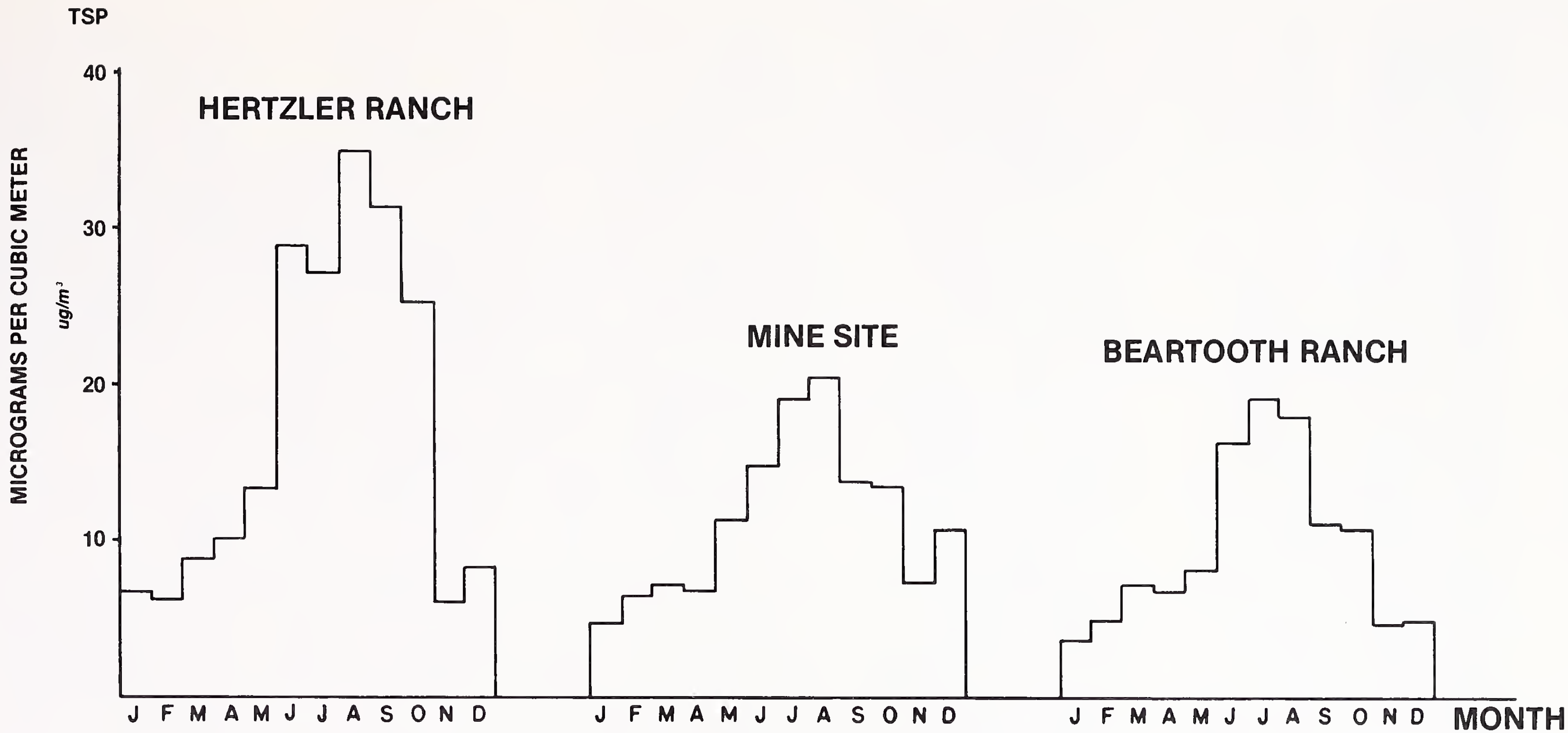
[d]Not to be exceeded more than once per year.

[e]Not to be exceeded more than 18 times in any 12 consecutive months.

[f]Not to be exceeded.

[g]Set as a guide to achieve photochemical oxidant standards.

[h]---indicates no standard.



	Hertzler Ranch	Mine Site	Beartooth Ranch
NUMBER OF SAMPLES	114	111	104
ANNUAL AVERAGE (ug/m^3)	17.6	11.4	9.6
GEOMETRIC MEAN (ug/m^3)	12.2	9.4	7.6
FIRST MAXIMUM[1] (ug/m^3)	89	41	43
SECOND MAXIMUM[1] (ug/m^3)	74	37	27

FIGURE III-16--Monthly Mean Total Suspended Particulate Concentrations (ug/m^3)

([1]First maximum means the highest 24-hour concentration measured; second maximum means the second highest 24-hour concentration measured.)

The major sources of TSP in the area are probably vehicle traffic and wind erosion. Thus, during the winter when road surfaces are frozen and disturbed areas are snow-covered, the TSP concentrations are lowest (fig. III-16). The entire area is classified as a Class II airshed, including the Absaroka-Beartooth Wilderness.

There are no major pollution sources in the area, so all other pollutants are present in only very low concentrations.

J. EMPLOYMENT AND INCOME

1. Employment

Despite the 9 percent decline in employment during the 1970s (table III-9), a loss of 63 basic industry jobs, agriculture remained the county's leading employer. An increase in manufacturing employment of 50 jobs partially made up for the decline in basic industry employment. Lead by increases in the derivative sector industries of trade, services, and nonfarm proprietors, total employment in the county went up from 1,782 jobs to 2,107 jobs, an average annual rate of 1.9 percent. The increase during the 1970s was a reversal of the trend of the preceding 20 years.

Fifty-three percent of the county's heads of households are employed, 2 percent are unemployed, and the remaining 45 percent are retired or are housewives (Entercom, 1981, p. 829). Unemployment in the county has generally run at a rate significantly below the State's rate for the past decade (table III-10) and, as of December 1981, stood at 5.3 percent, up from 3.3 percent the year before. The State's rate of 7.2 percent (Montana Department of Labor and Industry, January 1981) was also up from the 1980 figure of 6.0 percent.

Because of the increasing number of county residents who commute to jobs outside the county, the number of employed persons grew at a rate faster than the rate of employment growth, particularly during the second half of the 1970s. During the decade, the number of employed persons increased from 1,699 to 2,188 (table III-10), or at an average annual rate of 2.5 percent. The growth rate was much greater during the second half of the decade, growing at an average annual rate of 4.3 percent, compared to the 1.6 percent rate during the first half.

Twenty-three percent of the employed persons in Stillwater County commute to jobs outside the county (Entercom, 1981, p. 916); another 11 percent work both inside and outside the county. Intercounty commuters earned higher salaries than persons employed only inside the county; twenty-six percent of the residents that worked in jobs outside the county earned more than $24,000 in 1980; only 13 percent of the residents that worked only inside the county (Entercom, 1981, p. 940) earned that much. The intercounty commuters have not had as great an effect on the local economy as might be indicated by their greater-than-average earnings because their households are less likely to shop in

TABLE III-9--Employment by Major Industry in Stillwater County, 1970-79

[Sources: U.S. Department of Commerce, 1980a, 1981a]

	1970[a]	1971[a]	1972[a]	1973[a]	1974[a]	1975[b]	1976[b]	1977[b]	1978[b]	1979[b]
Agriculture[1]	684	694	686	679	702	670	632	605	585	621
Mining	(D)	(D)	(L)	(D)	(D)	(D)	(L)	(L)	(L)	(D)
Construction	23	29	31	32	31	21	36	50	56	50
Manufacturing	64	77	90	114	123	133	115	99	107	114
T.U.[2]	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	74
Trade	178	201	195	206	206	195	214	220	236	266
F.I.R.E.[3]	38	40	45	45	45	42	39	44	46	55
Services	(D)	(D)	(D)	126	142	152	(D)	(D)	(D)	(D)
Nonfarm Proprietors	261	229	246	244	262	267	269	282	297	312
Federal Government	71	71	75	71	75	72	63	59	65	68
State and Local Government	217	226	231	254	274	295	308	309	304	285
TOTAL	1,782	1,808	1,851	1,871	1,966	1,959	1,979	1,998	2,012	2,107

[a]Estimated based on 1967 Standard Industrial Codes.
[b]Estimates based on 1972 Standard Industrial Codes.
[1]Includes: farm proprietors, farm wage and salary employment, agricultural services, forestry, fisheries and other.
[2]Transportation and public utilities.
[3]Finance, insurance and real estate.
(D)Not shown to avoid disclosure of confidential data. Data are included in totals.
(L)Less than 10 wage and salary jobs.

TABLE III-10--Stillwater County Employment Statistics, 1970-1980

[Source: Montana Department of Labor and Industry, February, 1981]

Stillwater County					
Year	Labor Force	Employment	Unemployment Number	County Rate	Montana Unemployment Rate
1970	1,766	1,699	67	3.8	4.3
1971	1,838	1,733	105	5.7	4.8
1972	1,757	1,673	84	4.8	4.8
1973	1,774	1,699	75	4.2	4.8
1974	1,884	1,815	69	3.7	5.2
1975	1,938	1,843	95	4.9	6.4
1976	2,016	1,920	96	4.8	6.1
1977	1,968	1,864	104	5.3	6.4
1978	2,111	2,019	92	4.4	6.0
1979	2,263	2,188	75	3.3	5.1
1980	2,581	2,497	84	3.3	6.0

Note: Employment as used here is the number of employed persons by place of residence; this is different from the Department of Commerce employment figure, which measures the number of jobs by place of work.

Stillwater County than other county residents. Eighty-one percent of the residents employed inside the county, compared to 39 percent of those employed outside the county, usually shop for everyday items in Stillwater County (Entercom, 1981, p. 582). Most households in the county shop for major purchases outside the county, but persons working outside the county are even less likely to shop in Stillwater County; 26 percent of those working in the county compared to 8 percent of those outside shop in Columbus (Entercom, 1981, p. 586). Besides having greater opportunity to shop outside the county, intercounty commuters live closer to Billings and so are more likely to shop outside the county. Sixty-two percent of the intercounty commuters live near Park City, 23 percent near Columbus, and 13 percent live near Absarokee (Entercom, 1981, p. 913).

2. Income

The increasing trend for county residents to hold jobs outside the county is reflected in the county's personal income statistics. One of the items in the total personal income estimate made by the U.S. Department of Commerce is the "residence adjustment". (See table III-11.) This item reflects flows of earned income into the county because of intercounty commuters. During the 1970-74 period only 7 percent of Stillwater County's growth in total personal income was provided by growth in the residence adjustment (U.S. Department of Commerce, 1980b), compared to 34 percent of the 1974-79 growth (U.S. Department of Commerce, 1981b).

Income growth in the county during the 1970s was lead by increases in transfer payments, dividends, interest and rent, which provided 57 percent of the growth. These items, which reflect the importance of retired persons to the local economy, made up 43 percent of the county's total personal income in 1979. (See table III-11.) Net labor and proprietor's income has been adversely affected by poor earnings in the farm industry in recent years, but still managed to provide 9 percent of income growth during the decade and stood at 42 percent of the total in 1979.

K. SOCIOLOGY

1. Description of the Study Area

The sociology study area includes all of Stillwater County. (See fig. III-17.) The southern portion of the county includes 187,850 acres of the Custer National Forest. Columbus is the only incorporated town in the county.

Stillwater county is rural in character; agriculture has been the foundation of the local economy since the area was settled. The largest percentage of workers (28 percent) are employed in farming and ranching (Entercom, 1981). Although the Entercom study included foresty and fishing in the farming category, few county residents are employed in

TABLE III-11--Stillwater County Personal Income by Major Source, 1970-79
(thousands of dollars)

[Sources: U.S. Department of Commerce, 1980b, 1981b]

ITEM	1970[1]	1971[1]	1972[1]	1973[1]	1974[1]	1975[2]	1976[2]	1977[2]	1978[2]	1979[2]
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK[3]										
By type										
Wage and salary disbursements	4,762	5,314	5,977	6,756	7,833	8,467	9,054	9,758	10,529	12,695
Other labor income	217	258	297	352	445	555	644	713	742	948
Proprietor's Income[4]	5,009	5,220	7,025	6,598	6,710	5,055	-25	-656	6,012	2,945
Farm	3,852	3,924	5,726	5,199	5,212	3,541	-1,435	-2,192	4,171	878
Nonfarm[4]	1,157	1,296	1,299	1,399	1,498	1,514	1,410	1,536	1,841	2,067
By industry										
Farm	4,724	4,911	6,822	6,506	6,796	4,992	-103	-849	5,542	2,649
Nonfarm	5,264	5,881	6,477	7,200	8,192	9,085	9,776	10,664	11,741	13,939
Private	3,961	4,443	4,900	5,443	6,232	6,843	7,457	7,891	8,586	10,485
Government	1,303	1,438	1,577	1,757	1,960	2,242	2,319	2,773	3,155	3,454
DERIVATION OF PERSONAL INCOME BY PLACE OF RESIDENCE										
Total labor and proprietor's income by place of work	9,988	10,792	13,299	13,706	14,988	14,077	9,673	9,815	17,283	16,588
Less: personal contributions for social insurance by place of work	346	383	419	510	561	601	734	818	878	1,007
Net labor and proprietor's income by place of work	9,642	10,409	12,880	13,196	14,427	13,476	8,939	8,997	16,405	15,581
Plus: residence adjustment	858	963	1,089	1,225	1,388	1,523	1,748	3,463	5,098	5,783
Net labor and proprietor's income by place of residence	10,500	11,372	13,969	14,421	15,815	14,999	10,687	12,460	21,503	21,364
Plus: dividends, interest, and rent[5]	3,834	3,734	3,833	4,469	5,283	5,878	6,426	7,466	8,777	10,041
Plus: transfer payments	1,816	2,099	2,292	2,684	3,163	3,734	4,202	4,732	5,201	5,812
Personal income by place of residence	16,150	17,205	20,094	21,574	24,261	24,611	21,315	24,658	35,481	37,217

[1] Estimates based on 1967 Standard Industrial Codes
[2] Estimates based on 1972 Standard Industrial Codes
[3] Consists of wage and salary disbursements, other labor income and proprietor's income. Primary source for private nonfarm wages: ES202 covered wages--Montana Employment Security Commission.
[4] Includes the capital consumption adjustment for nonfarm proprietors.
[5] Includes the capital consumption adjustment for rental income of persons.

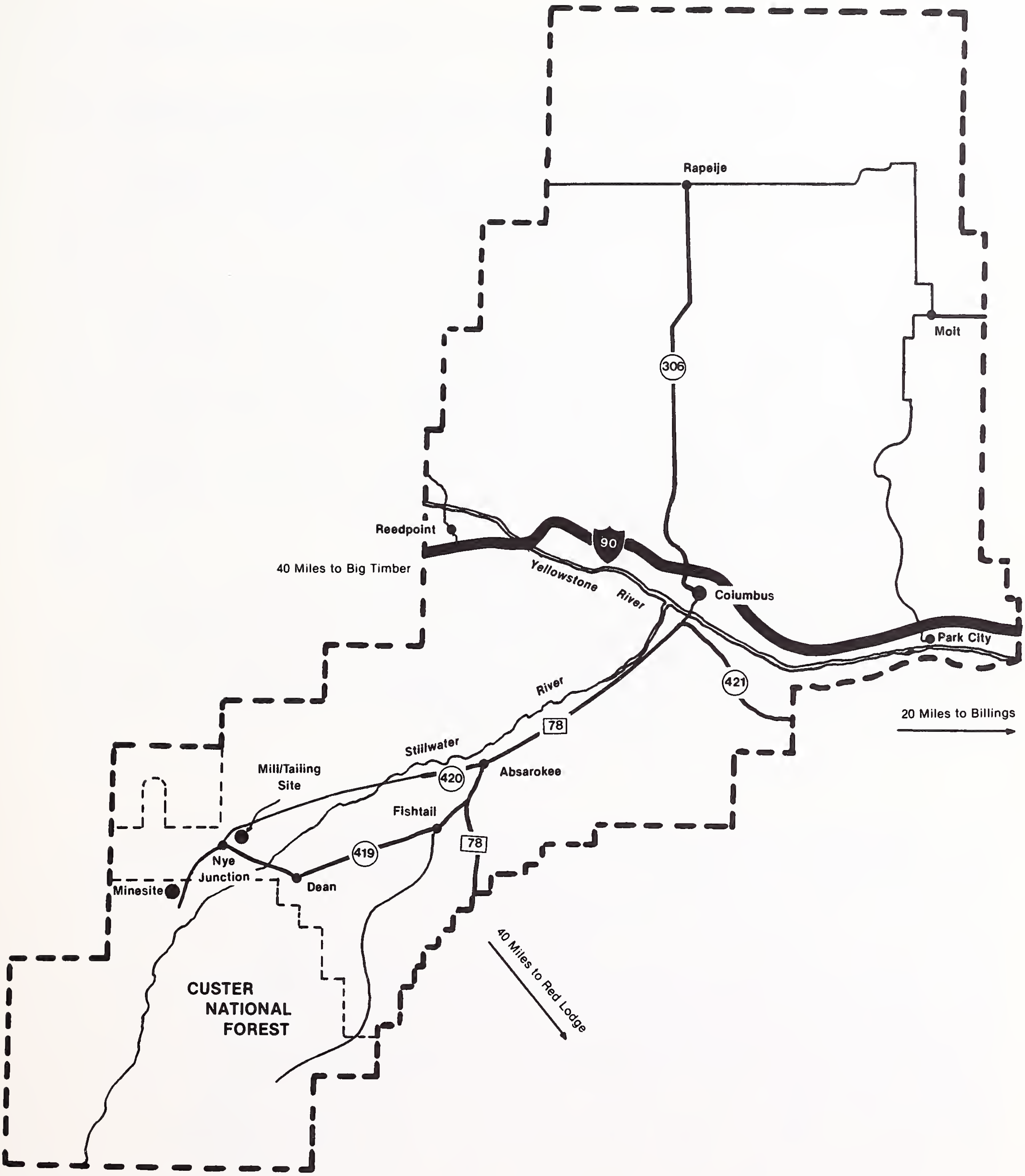


FIGURE III-17--The Sociology Study Area--Stillwater County

forestry or fishing operations (Mitch Press, Stillwater County Planner, oral commun., March 1982).

Previous mineral development and exploration brought a peak population of 1,900 in 1943 to the Nye area for less than three months. The highest number of people employed recently in mineral activity was 41 in the summer of 1981 during the engineering phase of Anaconda's project. The only other energy or mineral development in the county is a minor amount of oil and gas production in the northern part.

The metropolitan area nearest to Stillwater County is Billings, 41 miles east of Columbus. Seventy-five percent of the county's residents shop for major items in Billings and 23 percent work outside Stillwater County, most probably in Billings. Columbus is the county's trade center: 37 percent of the county's residents purchase everyday items such as groceries at Columbus; 17 percent also purchase major items, such as cars, furniture and household appliances. Other towns in the county, Absarokee, Fishtail, Beehive, Nye, and Dean, offer limited shopping. Park City serves as a bedroom community for Billings commuters: 60 percent of the residents in the Park City census division work outside the county (Entercom, 1981, p. 913).

The study area's proximity to the Billings metropolitan area has resulted in an increase in Stillwater County of (1) part-time residents who have built or purchased second homes for recreational purposes or for retirement; (2) through traffic by city residents on their way to Custer National Forest or the Absaroka-Beartooth Wilderness; and (3) suburban development in the communities closest to Billings (Camp Dresser and McKee [CDM], May 1981, p. 2.10-86).

2. Methodology

A survey was conducted in 1981 by Entercom, a research firm, to gain information on the employment, recreational activities, attitudes, and demographic characteristics of Stillwater County's residents. Three hundred eighty-two interviews were completed from a total of 3,139 households in the county. Households were selected using a systematic random sample that gave each household an equal chance of being selected. The adult in each household selected for an interview was also chosen by a method that gave each adult in the household an equal opportunity of being selected. Except where noted, the data in the remainder of this section comes from the Entercom Survey. The results of this survey are statistically accurate to within 5 percent at a 95 percent confidence level. Simply stated, if a sample of households were selected 100 times, 95 times out of the 100 the result obtained would not vary more than 5 percent from the results that would be obtained if all households in the county were interviewed (Entercom, 1981).

3. Demography

The county has no distinctive ethnic or cultural characteristics. Ninety-nine percent of the county's 1980 residents were white (U.S. Dept. of Commerce, 1981d).

The county's 1980 population was 5,598, up 21 percent over the 1970 figure (U.S. Department of Commerce, 1981c), following a downward trend since 1920 (Montana Department of Community Affairs, 1975). Much of the recent growth has occurred in the northern portion of the county; the Park City area has gained 49 percent.

The county has a high proportion of people 65 years and older--31 percent of the residents. Another 16 percent are between 55 and 64. The age categories 18 to 34 and 35 to 54 each accounted for 26 percent of the residents. In Absarokee, 60 percent of the households had members over 64; another 13 percent had members between 55 and 64.

Seventy-one percent of those surveyed are married and 16 percent are widowed. The average size of the households was 2.6. The largest proportion of households, 38 percent, have two people. Twenty-seven percent have four or more persons; 20 percent are single-person households; and 15 percent are three-person households.

The largest proportion of residents, 19 percent, earned between $16,000 and $24,000 in 1980. Of the remaining residents, 11 percent earned between $24,000 and $32,000; 10 percent earned between $4,000 and $8,000; 8 percent between $32,000 and $40,000; 8 percent less than $4,000; and 6 percent over $40,000. The remaining 15 percent did not respond. Twenty-three percent of employed persons work outside the county and 11 percent work both in Stillwater County and outside.

Twenty percent of those surveyed had attended some college; another 13 percent graduated from college and 6 percent (about half of all college graduates) did postgraduate work. The largest proportion, 41 percent, were high school graduates. Twenty-six percent had not completed high school.

Thirty-five percent of the county's 1981 population surveyed moved to the county in the last 10 years. By census divisions, this was true of 55 percent of Park City residents, 40 percent of the Columbus division residents, 29 percent of the Columbus town division residents, 32 percent of the Absarokee division residents, and 18 percent of the Stillwater North division residents.

4. Occupational Structure

Of the employed residents, 30 percent work in technical, clerical, sales, administrative or support occupations; 25 percent in farming, forestry, or fishing; 13 percent in managerial or professional speciality occupations; 12 percent in operations, manufacturing, or

labor; 11 percent in precision production, craft or repair occupations; and 10 percent in service occupations.

Forty-eight percent of those employed work for a private company, business, or individual. Twenty-seven percent are self-employed in their own business, professional practice, or ranch.

4. Values

According to Gold (1976), the people in Stillwater County generally value their current lifestyle because it is simple, not stressful, and gives them a sense of permanence.

Stillwater County's current residents chose to live there, according to those surveyed, for a number of reasons: 17 percent cited a farm, a ranch, a cabin, land or a business; 13 percent the desire to be near relatives; 11 percent the desire to be in a small community with peace and quiet; 11 percent the job opportunities; and 10 percent the beauty of the area. Additional reasons were given by less than 10 percent of the respondents.

Twenty-eight percent of residents surveyed stated that they must have either their family, a good relationship with their family, their family nearby, or be able to raise a good family to ensure a happy and satisfying life. Twenty-six percent cited good health; 20 percent adequate income; 14 percent a good job; 10 percent friends; and 10 percent recreation or a hobby. Other needs were listed by fewer than 10 percent.

Eighty-four percent of the households own their home or are purchasing it. This indicates a commitment to the area by a large majority of the households.

5. Attitudes and Concerns

Residents surveyed feel they now can have effective involvement in matters affecting their community; however, they are split as to whether or not there are adequate controls to ensure that individual interests are protected when in conflict with those of large corporations.

Directly relevant to the mine development issue are residents' perceptions of regulatory control of mining and reclamation efforts. While most residents feel that effective control is possible, a substantial minority (28 percent) do not.

Eighty percent of the survey respondents said they had heard or read something about a proposed mining operation in the county. In Absarokee, 91 percent were aware of the proposed mine, while in the northern portion of the county only 55 percent were aware of it.

Three primary advantages to development of Anaconda's project were seen by the residents surveyed: (1) job opportunities, mentioned by almost two thirds; (2) a boost to the area's economy, mentioned by nearly half; and (3) a broader tax base for the county, mentioned by 29 percent. Other advantages mentioned by 10 percent or fewer individuals included population growth, better school system, better roads, development of domestic rather than importing foreign minerals, and improvement of the housing industry. Four percent did not see any advantages to the residents of Stillwater County.

Despite these advantages, those surveyed listed more disadvantages. Three themes underlay the nine most mentioned disadvantages. The first theme, population influx, was mentioned by 30 percent of the respondents as the main disadvantage. The residents fear that development would bring too many people into the area too quickly and that many of the in-migrants would be transient or undesirable, thereby increasing crime. Many residents felt there would be rapid social change and social problems.

The second theme, overburdening of the county's public service system, was mentioned by 29 percent as the main disadvantage of the project. Of specific concern were the burdens on schools, roads, law enforcement, water supply and sewer systems, medical care, and fire protection. The third theme, environmental problems caused by development, including air, water and noise pollution, loss of wilderness, loss of wildlife, and scarring of the land was mentioned by 20 percent as the main disadvantage.

Other concerns mentioned, but by fewer than 10 percent, were additional taxes left to county residents following the population decline after mining; hardship for ranchers; increased living costs; and creation of a boom town. Eight percent felt there would be no disadvantages to county residents.

The residents surveyed clearly felt that job opportunities, local economic stability, and, to a lesser extent, shopping facilities, medical and mental health facilities, and cultural opportunities would be improved by development of the project. The residents also clearly felt that air, water and scenic quality, housing costs and availability, ranching and farming, and friendliness and concern of neighbors would be adversely affected.

L. COMMUNITY SERVICES

The part of Montana likely to be affected by the Anaconda Stillwater Project, and therefore the area analyzed here, is Stillwater County. The demand on future services projected below would occur even without the addition of the proposed project.

1. Schools

a. Columbus

The elementary school in Columbus is now at capacity with 211 students in kindergarten through grade five. The high school has capacity available for 76 additional students; the current enrollment is 224 (Briscoe, Maphis, Murray, and Lamont, Inc. [BMML], 1981).

Enrollment is expected to increase in the county's schools because more children are in the one-to-five-year-old category than in either the six-to-ten or eleven-to-fifteen age category (Jim Richard, consultant to Stillwater County, personal commun., February 26, 1982). The Columbus elementary school needs expansion; a bond issue was approved but not sold (BMML, 1981).

b. Absarokee

The elementary school in Absarokee has room for 35 additional students, if the incoming children are in the grades with the most capacity; current enrollment is 182. The high school also has capacity for 35 more students; the enrollment is 105 (BMML, 1981). About 35 students from the Nye and Fistail area attend school in Absarokee because the schools in their districts are at capacity. Recently, enrollment has been relatively stable; however, a large increase is expected in grade-school children throughout the county beginning in 1984. The district has no expansion plans (BMML, 1981).

2. Solid Waste

The County Greenbox Program (centrally located trash bins) serves the unincorporated portions of the county. It is currently near capacity. The county disposes of waste at the Billings landfill, a site adequate for the foreseeable future. The county has one 32-yard, one 75-yard, and one backup trash compactor. The county plans to place another compactor on a truck recently purchased. The town of Columbus has a collection system that feeds into the county transfer site for disposal. Absarokee has a private collection system, operated by volunteers, that feeds into the greenboxes for disposal (BMML, 1981).

3. Law Enforcement

The Stillwater County Sheriff's Department is a consolidated service that provides law enforcement to Columbus and the unincorporated portions of Stillwater County. It handles dispatch service for the Columbus Fire Department, the Columbus Rural Fire District, and the Columbus ambulance, as well as for law enforcement.

The department has the equivalent of 13 full-time sworn officers. Complaints in the Absarokee/South County district are generating a need for an additional deputy in that area; three deputies are located in

Columbus and one in Absarokee. The county jail has an overnight capacity of four persons. A new jail is needed: facilities currently used by Stillwater County in other counties are nearing capacity. There are no plans for expansion, however (BMML, 1981).

4. Water Supply

The city of Columbus water system serves the residents of Columbus and a limited area outside the city limits. The city has a virtually unlimited supply of water from the Yellowstone River. Average use is greater than 600,000 gallons per day. Summer use peaks at an additional 200,000 gallons per day. The system is capable of serving 1,600 to 1,700 people.

The Absarokee Water Users Association system serves the Absarokee town area. The system meets all state water quality standards, and could accommodate 10 to 50 new residences; however, a new well may be needed for winter supply, and some of the system's pipes now leak. The association has an unlimited water right (BMML, 1981).

5. Sewer System

Columbus's sewer system provides service to residents in the city. The system uses two large and two small evaporation ponds. The city has no firm plans for expansion; however, the system is thought to be at capacity now. The condition of the sewer lines is not known; the system is old, but it is thought that little infiltration is occurring. Regulatory performance is adequate (BMML, 1981).

Rural Special Improvement Districts Nos. 5 and 7 operate as one district and service the residential area of Absarokee. The system consists of sewer lines and collectors and a 1.5-acre lagoon. The district needs another 7 acres of lagoon space to meet U.S. Environmental Protection Agency (EPA) standards. There is no room for expansion at the current site, but adequate space is available nearby. No funds have been identified to support the expansion. The system has a significant infiltration problem. The fecal coliform count is above EPA standards (BMML, 1981).

6. Fire Protection

The Stillwater County Rural Fire Department serves the portions of the county that are outside fire districts. The department also has mutual aid agreements with the fire districts. The department is equiped primarily to handle wildfires, for which the six volunteers are considered adequate. The Department is generally unable to save burning structures because of the distance to most of the county from Columbus (Terry Nystel, Chief, Stillwater County Rurual Fire Department, oral commun., April 1982). As a result, the parts of the county outside the fire districts are not well protected against structural fires.

The Columbus Volunteer Fire Department services the town of Columbus. The department has 20 volunteers. The district would like to acquire one additional mini-pumper (BMML, 1981). The department has a limited mutual aid agreement with the Absarokee Rural Fire District, under which the Columbus Deparment will respond to fires within the townsite of Absarokee.

The Absarokee Fire District covers the southern part of the county and responds to calls on the national forest. The district has 28 volunteers from Absarokee and 28 from Nye. The district has adequate equipment and manpower (Eugene Lukkes, Absarokee Fire District, oral commun., March 1982).

7. City Shop

The Columbus City Shop maintains the city streets (which are in fair condition), the airport, cemetary, city parks, and city buildings, and operates the town's solid waste collection system (Terry Johnson, oral, commun., March 1982).

8. Ambulance

The Columbus Junior Chamber of Commerce (Jaycees) provides ambulance service to the town of Columbus, halfway to Absarokee, west to the county line, 12 miles toward Park City and to all of the northern portion of the county. Twelve volunteers answer an average of five calls monthly. The number of volunteers is considered adequate. Two of the volunteers are emergency medical technicians (John Bartos, Stillwater Community Hospital Administrator, oral commun., April 1982). The ambulance service is fully equipped, except for a tool to cut apart wrecked vehicles to free accident victims (BMML, 1981). The southern part of the county is serviced by the Absarokee Ambulance, which is operated by the same volunteers as the Absarokee Fire District. None of the volunteers are certified emergency medical technicians. No additional equipment is needed. The ambulance is funded privately and responds to an average of six calls a month (Eugene Lukkes, Chief, Absarokee Fire District, oral commun., April 1982).

9. Hospital and Medical Personnel

The Stillwater Community Hospital primarily serves Stillwater County. Fifty-seven persons are employed at the hospital, including 3 physicians, 9 nurses, and 4 licensed practical nurses. The hospital has maintained a nearly constant 40 percent occupancy rate over the last 3 years. The hospital has 27 beds. The hospital is now under expansion, and planning is underway for expansion of the emergency facilities. Some Stillwater County residents use Billings hospital facilities, particularly for special problems (BMML, 1981).

Three dentists and two optometrists also serve the county. This is an adequate number (John Bartos, Stillwater Community Hospital, oral commun., April 1980).

The Stillwater Convalescent Center operates close to its 82-person capacity most of the time. The center provides intermediate and skilled care. Although most patients are over 60, some are children or young adults. The center employs 80 persons, including 6 registered nurses, and 8 or 9 licensed practical nurses, (Sonja Heigis, Stillwater County Convalescent Center, oral commun., March 5, 1982).

10. Human Services

The Stillwater County Mental Health Center employs one full-time psychologist, a three-fifths-time alcohol counseling worker, and one half-time mental health worker. Their programs include out-patient care, home visits, emergency services, consultation and education, services to alcoholics and drug abusers, aftercare, services to the elderly and children, and screening and diagnosis. The center had 1,493 patients over a one-year period in 1980-81 (BMML, 1981).

The Stillwater County Welfare Department administers economic assistance through the following programs: aid to families with dependent children, Medicaid, medical assistance to the needy, food stamps, general assistance, and supplemental security. Social services provided include the following: child welfare, foster care, day care, adoption, and services to the elderly and developmentally disabled. The professional staff includes a director, one social worker, one social services aide, and two eligibility technicians, all of whom work half time for Stillwater County and half time for Sweetgrass County. Other staff include one home attendant and one clerical worker (BMML, 1981).

11. Housing

The characteristics of Stillwater County's housing are typical of rural counties. Most housing units are single-family homes; few apartments are available. In the Columbus and Absarokee areas, mobile homes represent a small percentage of total housing. A study conducted in 1977 concluded that 89 percent of the county's housing was structurally sound (Camp Dresser and McKee, 1981).

In 1980 the county had 2,481 year-round housing units; 84 percent were occupied. Of the 409 year-round units that were vacant, 216 were held for occasional use; only 55 were for rent (U.S Department of Commerce, 1981d).

M. FISCAL CONDITIONS

1. Stillwater County

In Stillwater County, general fund revenues come primarily from property taxes (Briscoe, Maphis, Murray and Lamont, Inc. [BMML], September, 1981, p. 2-32). For the past three years property taxes made up an average of 60 percent of total new general fund revenues. Federal payments in lieu of taxes (PILT) and State reimbursements, the second largest source, averaged 38 percent of the total. Fees, collection,

licenses and permits made up the balance. During the fiscal year 1980-81, property taxes raised about $352,000 for the general fund; PILT and State reimbursement amounted to about $224,000.

The other major county funds--road, bridge and poor fund--also received most of their revenue from property taxes.

Of the $1,522,478 budgeted by the county for all purposes in fiscal year 1980-81, 41 percent were for roads and bridges, 24 percent for general government, 12 percent for public safety, 9 percent for the poor fund, and the remainder for other general fund purposes.

2. Schools

The elementary school and high school in Absarokee rely primarily on property taxes raised in their districts for revenue. During the 1980-81 school year, approximately 69 percent of elementary district's and 68 percent of the high school district's budgets were funded through district and county levies. The balance was provided by the State through the school foundation program (Camp Dresser and McKee [CDM], May, 1981, p. 2.10-56). The schools in Columbus were slightly more dependent on State revenues: local revenues made up 66 percent of the elementary school budget and 65 percent of the high school budget.

3. Tax Base

In 1980 the county's tax base, or taxable value, was made up of agricultural land, improvements, machinery and products (43 percent); other land and improvements (19 percent); Montana Department of Revenue allocations of intercounty property (18 percent); personal property (12 percent); and the value associated with oil and gas production in the county (7 percent).

Inflation steadily eroded the county's tax base during the 1970s. The county's taxable value declined by 25 percent (in real terms) over the decade. To keep up with inflation the total average mill levy for State, county and school purposes steadily increased throughout the decade. Between 1970 and 1980 the tax rate (mill levy) increased by 50 percent, rising from 128.19 mills to 192.61 mills. Despite the increase, the combination of a 25 percent decline in the real value of the tax base (in constant 1967 dollars) and a 20 percent increase in population resulted in a decline in real per capita receipts. In 1970 there was an average of about $211 (1967 dollars) available for each county resident to provide basic county and educational services; in 1980 there was an average of only $197 (in 1967 dollars) available.

N. LAND USE

1. Proposed Permit Area and Surroundings

The part of the permit area around the mine facilities (90 acres) is dominated by mining land uses. (See fig. III-18.) The current

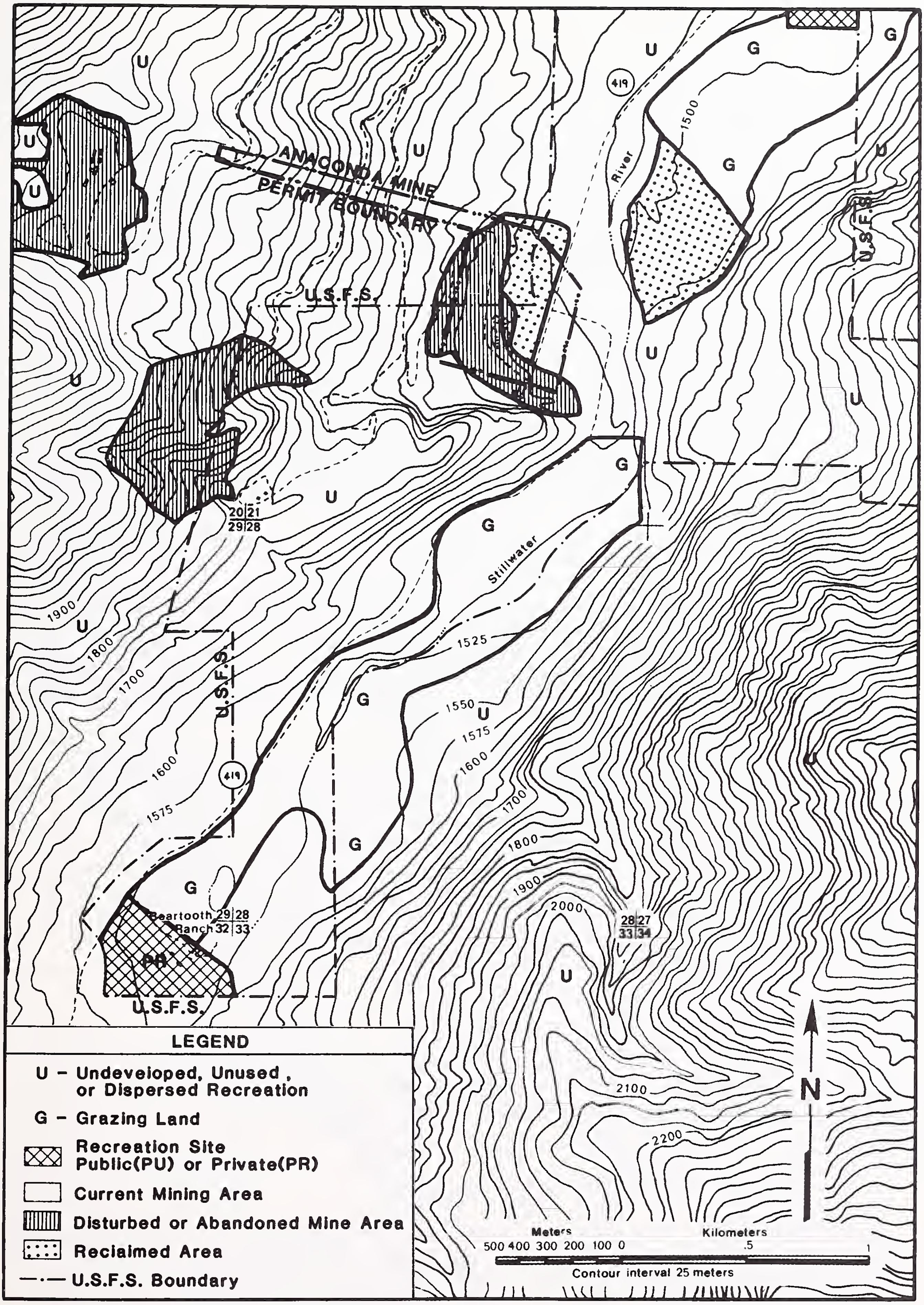


FIGURE III-18--Land Use in the Mine Area

mining area takes up about 25 acres, and much of the balance is made up of land previously disturbed by mining. The part of the permit area around the mill site (770 acres) consists largely of grazing land and irrigated hayland. (See fig. III-19.) The proposed permit area is currently in low-good range condition and has a stocking rate of 37 cow-calf units out of a potential of 59. (See Vegetation.) There is no domestic livestock grazing on the national forest part of the permit area.

The proposed permit area is located in the Stillwater River drainage in the southwest corner of Stillwater County. About 50 percent of the approximately 25,000 acres surrounding the area that were studied for this analysis are undeveloped and used for dispersed recreation and wildlife habitat (Camp, Dresser and McKee, [CDM]), 1981, p. 2.9-26). (See fig. III-20.) Agriculture, largely livestock grazing, makes up about 42 percent of the area. Residential and recreational uses make up most of the balance.

2. Current and Previous Trends

No major changes in land uses or associated activities took place between 1900 and 1960 in the 25,000-acre study area around the proposed project. For this period, the Stillwater River Valley was primarily an agricultural area (CDM, 1981, p. 2-9-23); however, during World War II and the Korean conflict, U.S. price supports allowed the mining of chrome near the proposed mine.

Transitions in land uses began to occur in the late 1960s and early 1970s. The outdoor recreational potential of both public and private lands in the area attracted many people to the county and brought on the conversion of agricultural land to residential uses (CDM, 1981, p. 2.9-23). Between 1970 and 1980, about 7,000 acres of privately owned land were converted from agricultural to suburban tracts (Montana Department of Revenue, 1970, 1980). The current high interest rates and the 1974 subdivision legislation have since reduced the number of land sales in the county (CDM, 1981, p. 2.9-24).

O. TRANSPORTATION

The roads that would be most affected by the proposed project are Federal Aid Secondary (FAS) 419 between Absarokee and the minesite and Federal Aid Primary (FAP) 78 between Columbus and Absarokee. (See fig. III-17.)

1. Federal Aid Secondary 419

FAS 419 is an improved two-lane roadway constructed in the early 1940s by the Montana Department of Highways and the U.S. government to provide improved access to the Benbow Mine and the Mouat Mine. Neither mine now operates; the roadway functions as the main route serving the communities of Fishtail, Dean, and Nye, as well as the numerous ranches and new rural developments in the area. Area ranchers occasionally move

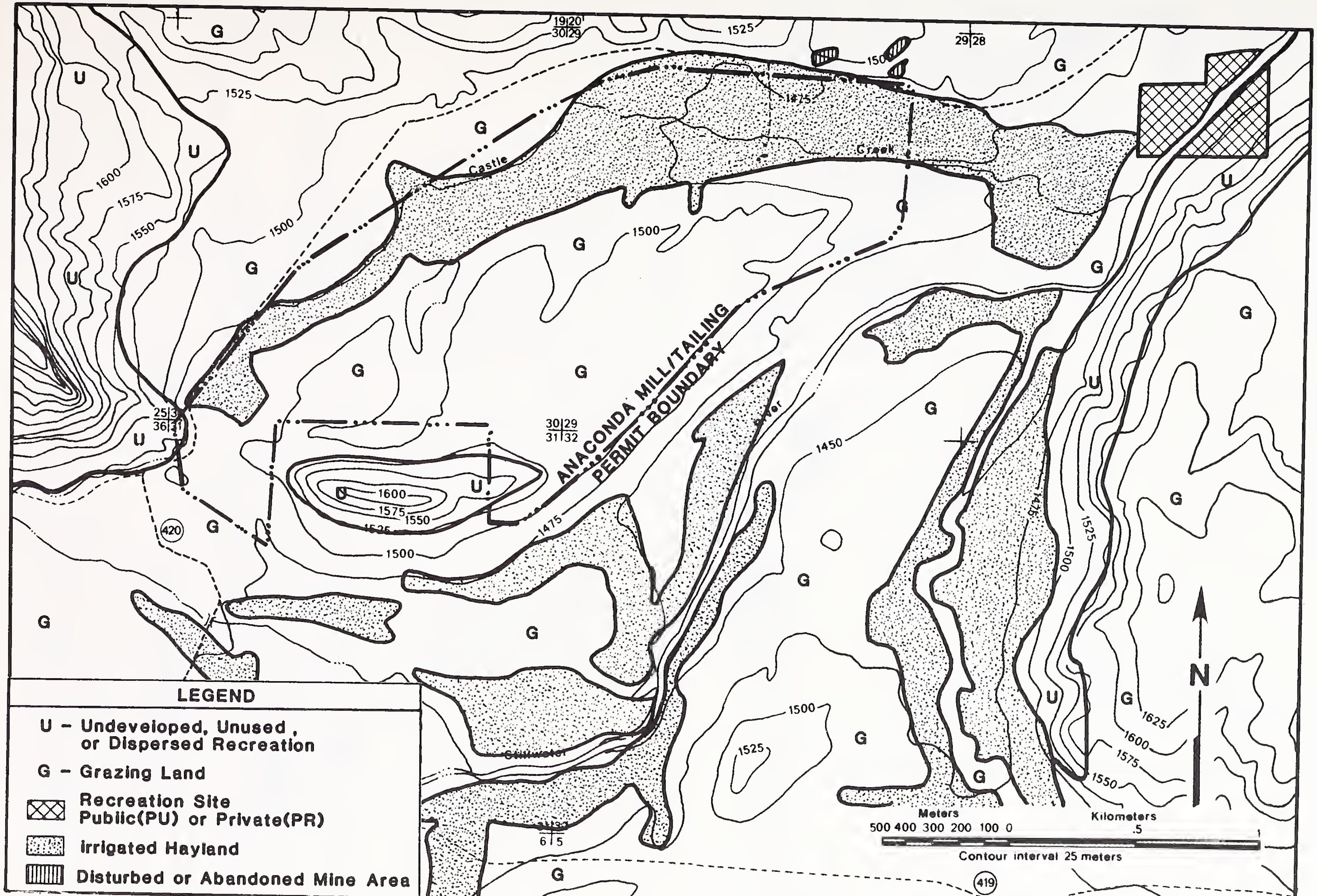


FIGURE III-19--Land Use in the Mill/Tailing Area

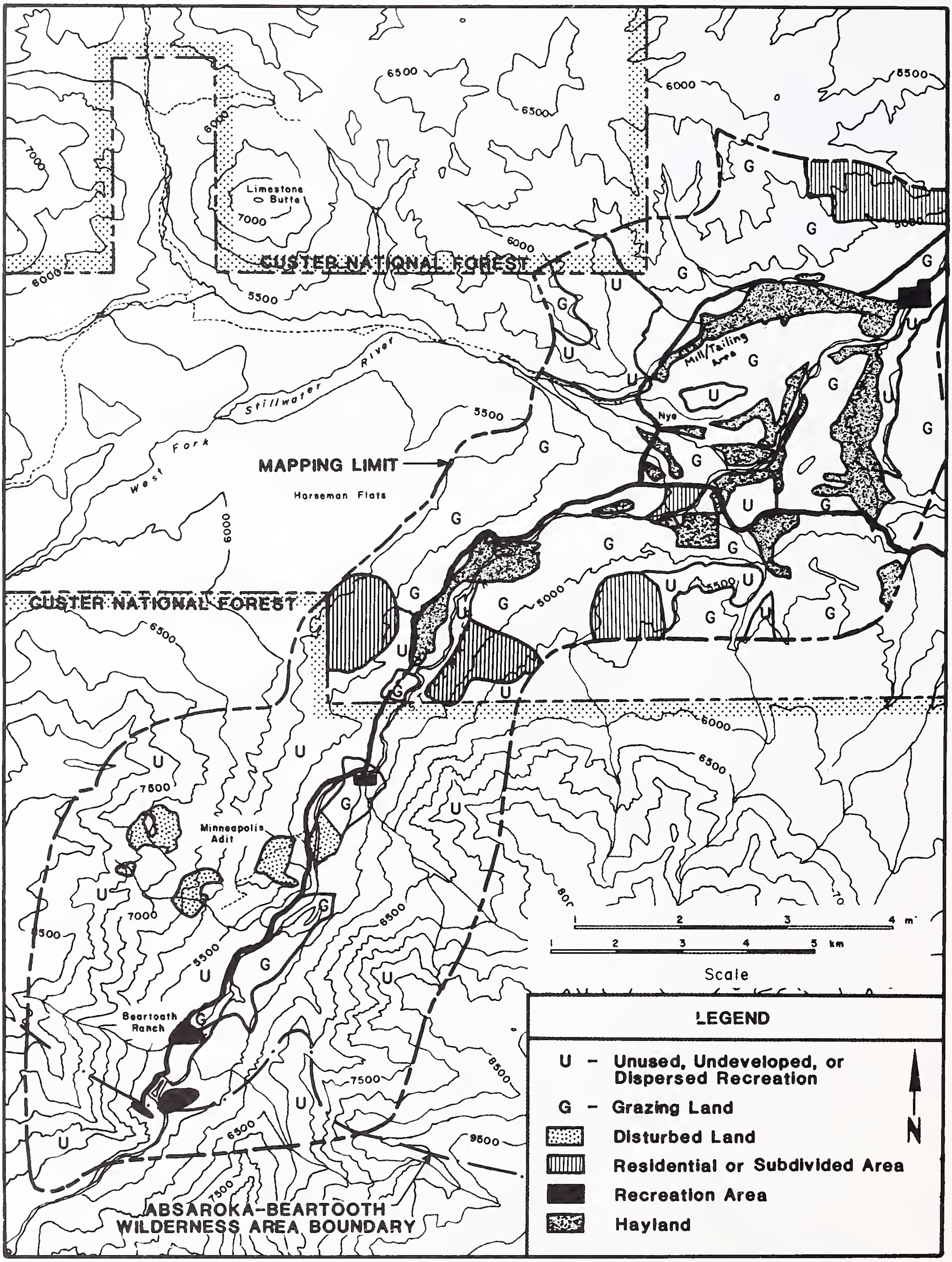


FIGURE III-20--Land Use of the Study Area
(Note: The National Forest boundary shown is the proclamation boundary. Private land holdings lie within this boundary. See fig. I-5.)

livestock along and across the road. Recreational and tourist traffic also use this route to get to resort ranches, fishing access sites, Woodbine Campground, and the trailheads in Custer National Forest (HKM Associates, 1981, p. 5).

Average daily traffic (ADT) has been increasing on FAS 419 at an average rate of 3.5 to 4.0 percent per year over the past 10 years and can be expected to continue to grow (HKM, 1981, p. 16). The 1980 ADT was 355 vehicles per day.

Both FAS 419 and FAP 78 have accident rates significantly higher than the overall State rate. During the period January 1, 1977, through April 30, 1981, there were 90 reportable accidents on FAS 419, an accident rate of 8.49 accidents per million vehicle miles (HKM, 1981, p. 18), which compares to a statewide rate of 2.89 on the secondary system. Three people were killed and 60 were injured in the 90 accidents.

The major existing problems with FAS 419 include a lack of shoulders, a number of inadequate bridges and sharp curves, inadequate signing, poor road surface condition, poor drainage, and narrow right-of-way in some areas (HKM, 1981, p. 60). The design capacity of FAS 419 as presently constructed is approximately 330 vehicles per hour or an ADT capacity of 2,200 (HKM, 1981, p. 63).

2. Federal Aid Primary 78

FAP 78 was built in 1935 and improved in 1945 by the Montana Department of Highways. It serves as the main north-south highway in the region. Traffic on FAP 78 remained fairly constant between 1975-80 and in 1980 stood at 1,014 (Montana Department of Highways, 1980, p. 93).

During the period 1976-79, there were 99 accidents on the stretch of FAP 78 between Columbus and the Fishtail cutoff (CDM, 1981, p. 2.9-12). The road's accident rate was 3.35, which compares to a statewide rate of 2.50 on the primary system. Seven people were killed and 35 were injured in 99 accidents.

The major existing problems associated with FAP 78 include deteriorated foundations and road surface, poor drainage and a poor safety record. The Montana Department of Highways currently considers 9.4 miles of the 15.8-mile segment northeast of Absarokee as deficient (Montana Department of Highways, 1980, p. 93). FAP 78 has a design capacity of 450 vehicles per hour or an ADT capacity of 3,000.

P. RECREATION

1. National Forest Recreation

The activity and population increase from the proposed Anaconda Stillwater Project would occur in the Nye and Absarokee areas of Montana. The main national forest lands affected, owing to their proximity to roads, would be the drainages of the Stillwater River and of

East and West Rosebud Creeks. The project may also influence peripheral areas, but to a minor degree.

About 336,000 acres of national forest lands lie in the Stillwater and Rosebud drainges, all on the Beartooth District of the Custer National Forest. Of this total, 233,000 acres lie within the Absaroka-Beartooth Wilderness and 103,000 acres lie outside. The Wilderness covers most of the lands near the Anaconda Stillwater Project. In the Rosebud drainages it excludes only a narrow corridor along the roads and the north face of mountains; in the Stillwater drainage it generally follows the south side of the minerals complex. (See fig. III-21.)

The Beartooth Mountains are characterized by majestic peaks, deep canyons with narrow bottoms and sheer walls, high tundra plateaus, glaciers, and swift, cold streams. The highest point in Montana, 12,799-foot Granite Peak, is located at the head of East and West Rosebud Creeks. The national forest boundary is located at the break between foothill grasslands and steep, timbered mountain faces.

Each major stream is paralleled by a road that ends five to seven miles inside the forest boundary. Along the roads in East Rosebud, West Rosebud, and Stillwater canyons lie campgrounds, picnic areas, fishermen parking areas at lakes, and trailhead parking areas. (See tables III-12, III-13, and III-14.) Generally, less than one-half mile of trail links the trailheads with the Wilderness boundary. The exception is in West Rosebud Canyon, where the boundary is about six miles from the trailhead.

The canyon of the West Fork of the Stillwater is accessed by Forest Service Road 846. The distance from the mine area to the end of the road is about six miles. There are two small parking areas at the end of the road with very limited camping space. In addition, a primitive camping area, with a corral and horse ramp, lies at Initial Creek, about one-half mile before the end of the road. The Benbow, Picket Pin, Meyers Creek-Lodgepole, and Red Lodge Creek roads service no developed recreation sites, although undeveloped camping areas lie beside the roads.

The nearest large population center is Billings, Montana, about 1½ hour driving time away. Billings and the Yellowstone Valley area supply about 70 percent of the national forest recreation visitors to the lands near the project.

Most recreation use occurs during the summer from mid-June through Labor Day weekend. (See tables III-15 and III-16.) Weekend use is much higher than weekday use. Winter use appears to be increasing but use levels are unknown. Woodbine Campground and Trailhead are accessible and used almost year-round. West Rosebud Road is kept open year-round to serve people living at the Mystic Power Plant. East Rosebud Road is not plowed beyond the national forest boundary, and access to the end of the road is generally limited to May through November.

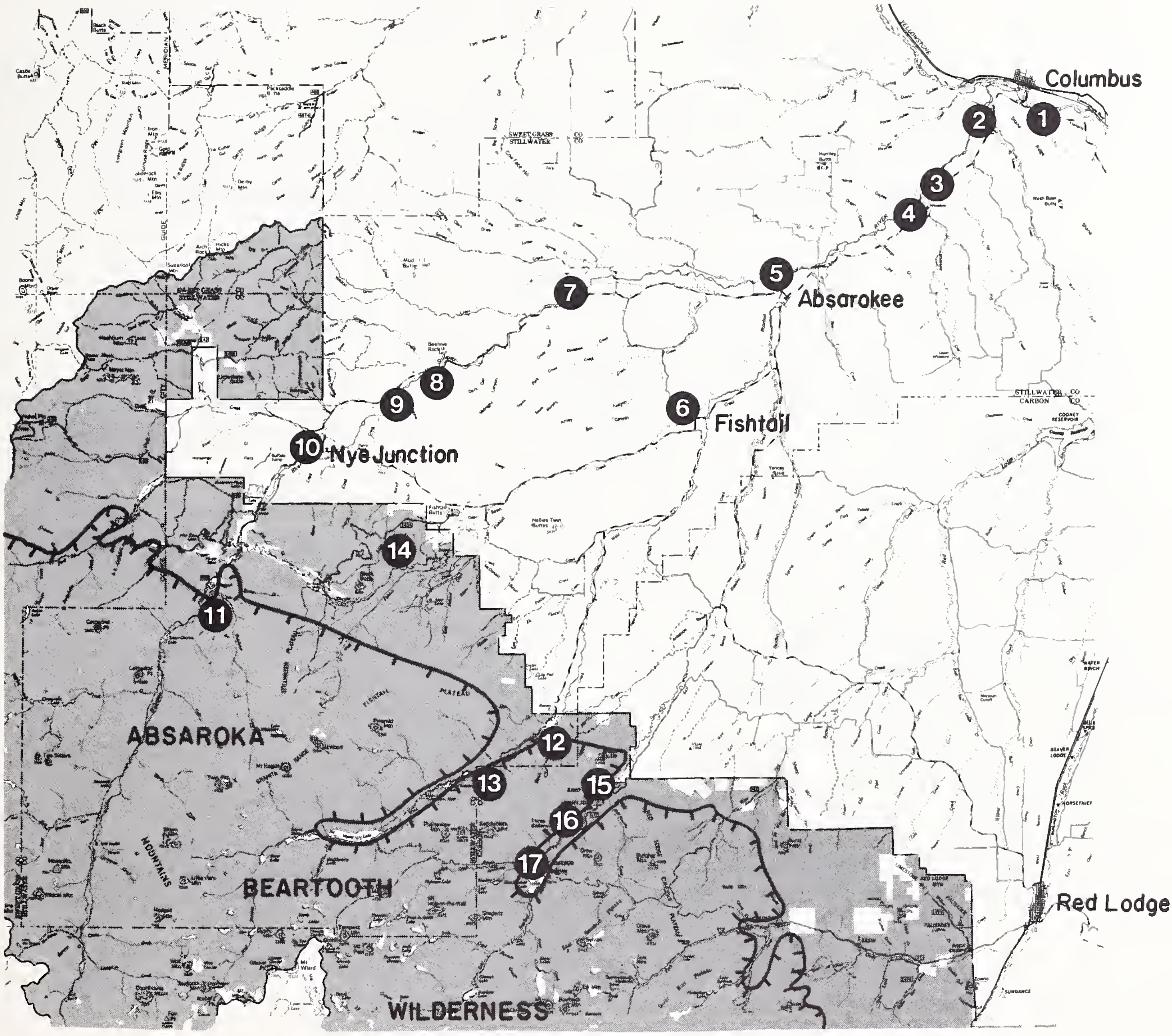


FIGURE III-21--National Forest Lands (shaded) and Recreation Sites in Area Surrounding the Project, Showing Wilderness Boundary

1. Itch-Kep-Pe: State fishing access site and campground.
2 Firemans Pont: State fishing access site.
3. Swinging Bridge: State fishing access site.
4. Whitebird: State fishing access site and campground.
5. Absaroka: State fishing access site.
6. Rosebud Isle: State fishing access site.
7. Cliff Swallow: State fishing access site.
8. Castle Rock: State fishing access site.
9. Moraine: State fishing access site.
10. Buffalo Jump: State fishing access site.
11. Woodbine: U.S. Forest Service campground with fishing.
12. Pine Grove: U.S. Forest Service campground with fishing.
13. Emerald Lake: U.S. Forest Service campground with fishing.
14. Little Rocky: U.S. Forest Service campground with fishing.
15. Sand Dunes: U.S. Forest Service picnic area with fishing.
16. Jimmy Joe: U.S. Forest Service campground with fishing.
17. East Rosebud: U.S. Forest Service campground with fishing.

TABLE III-12--Developed Campgrounds and Picnic Areas

[Source: Recreation Improvement Records, Custer National Forest]

Campground or Picnic Area	Number of Camp or Picnic Units	Persons at One Time (PAOT) Capacity
East Rosebud Lake	12	60
Jimmie Joe	10	50
Sand Dunes (picnic)	10	50
Emerald Lake	28	140
Pine Grove	46	230
Woodbine	46	230
TOTAL	152	760

TABLE III-13--Developed Trailheads and Constructed Parking Areas

[Source: Recreation Improvement Records, Beartooth District, Custer National Forest]

Name	Vehicle Parking Capacity
East Rosebud Trailhead (horse ramp)	40
Senia-East Rosebud Trailhead	5
Phantom Creek Trailhead	10
West Rosebud (Mystic) Trailhead	45
West Rosebud Lake Fisherman Parking (4 areas)	40
Emerald Lake Fisherman Parking (2 areas)	25
Woodbine Trailhead (horse ramp, corral)	50
Woodbine Falls Trailhead	8
West Fork Stillwater Trailhead (2 areas)	12
TOTAL	235

TABLE III-14--Occupancy Spots[1] on Public Roads--Number and Capacity

[Source: 1979 & 1980 Inventories, Beartooth District, Custer National Forest]

Road	Total Camp Units	PAOT[2] Existing	PAOT[2] Potential
Picket Pin Road	6	30	0
Meyers Cr.-Lodgepole Cr.	10	50	0
West Fork Stillwater (Initial Cr.)	8	40	0
Main Stillwater	12	60	0
Benbow Road	8	40	0
West Rosebud	17	35	50
East Rosebud	34	100	70
Red Lodge Cr.	15	75	0
TOTAL	110	430	120

[1]An occupancy spot is an undeveloped site used repeatedly for camping and or picnicking. Potential site is defined as physicaly usable, but currently unused for some reason--generally poor vehicle access.

[2]Capacity in "people at one time" that can use the site.

TABLE III-15--Campground Use--Average Number of Units Occupied by Month and Year

[Source: Recreation Use Records, Beartooth District, Custer National Forest]

		1979		1980		1981		
Campground	Month	Counts[1]	Average Units Occupied	Counts[1]	Average Units Occupied	Counts[1]	Average Units Occupied	3-year Average % of Capacity
Woodbine	July	16	33	12	26	14	23.7	60
	Aug.	9	29.3	11	26.9	14	24.5	58
Pine Grove	July	18	19.3	8	23.2	15	24.3	48
	Aug.	8	14.8	11	16.1	16	18.7	36
Emerald Lake	July	18	24.6	9	24.7	15	19.6	82
	Aug.	8	22.5	10	19.4	17	17.9	70

[1]Number of days when actual count was made of units occupied.

TABLE III-16--Average Daily Trail Use[1]

[Source: Recreation Use Records, Beartooth District, Custer National Forest]

	East Rosebud Trail			West Rosebud Trail			Stillwater Trail		
Month	1979	1980	1981	1979	1980	1981	1979	1980	1981
June	35	30	47	35	26	30	52	50	46
July	63	54	60	41	41	48	59	79	73
August	71	64	54	40	43	45	61	61	65
Sept.	35	26	35	27	15	20	40	22	41
TOTAL Visitors for a 4-month period	6,254	5,338	5,994	4,371	3,834	4,683	6,480	6,500	6,888
Change from previous year		-15%	+12%		-12%	+22%		0%	+6%

[1]Accuracy of samples from electric eye counters indicates composite error factor of ±1. Figures are in total numbers of people.

Public access to national forest lands is limited to the eight roads listed in table III-14. Most summer recreation use takes place in the canyons with fishable streams and lakes. These areas have reasonable public access except during the big game hunting season, according to the Forest Service. Some parts of the forest boundary are without public access. This situation exists between West Rosebud and the Benbow Road and along a 13-mile stretch of the national forest boundary just northwest of the proposed mill site. Most private landholders permit selective entry through their lands, but some are restrictive.

Demand exceeds supply for improved recreation space on national forest lands on holiday weekends and occasionally on other weekends. The average daily use of most campsites is in the 60 to 70 percent range for July and August. Typically, visitors arrive on Friday afternoon or evening and depart around noon on Sunday. This pattern creates a traffic load from 3:00 to 9:00 p.m. on Friday and from 1:00 to 6:00 p.m. on Sunday. The overload persists all the way to Columbus. Expected growth in future use, if the project were not to occur, is presented in table III-17.

All of the land in the study area will carry a certain number of visitors through time without biological degredation. This capacity varies with numbers, length of stay, habits of the visitor, and individual site factors. At the present time, on the national forest, the biological capacity has not been reached, although some sites have been closed to camping and building of fires to allow recovery.

The carrying capacity estimates shown in tables III-14 and III-18 are based on an intensive level of management. In 1980 and 1981 this included five recreation staff in the Stillwater River and West and East Rosebud Creek drainages. As the level of management drops, the U.S. Forest Service estimates that the carrying capacity will drop. No effort was made to determine the social carrying capacity of the area.

2. Off-Forest Recreation

People also participate in dispersed activities outside national forest lands, including kayaking, canoeing, and rafting along the Stillwater and Yellowstone Rivers, and fishing at 11 access sites owned by the Montana Department of Fish, Wildlife, and Parks (Camp, Dresser and McKee [CDM] May 1981, p. 2.10-84). (See fig. III-21.)

The visitation of fishing access sites on the Stillwater River is high according to the Department of Fish, Wildlife, and Parks. Most sites are used for picnicking as well as fishing. Visitor use of the 11 sites in 1981 ranged from 4,100 visitors at the Moraine site to 13,400 at Indian Fort, with the exception of Absarokee site, which had an estimated 500 visitors (Roy Burnsten, Regional Park Manager, Montana Department of Fish, Wildlife, and Parks, oral commun., March 1982).

The State of Montana owns three campgrounds in Stillwater County with a total of 43 campsites, and eight picnic grounds with a total of

TABLE III-17--Recreation Demand Trends for the Beartooth Planning Unit

[Source: Background Reports, Beartooth Face Planning Unit, Custer National Forest, 1978.]

Category of Recreation	Forecasted Growth
Primitive (backpacking, mountain climbing)	+1.3% annually
Hunting, fishing, woodcutting	+8.2% annually
Road-oriented dispersed recreation	+7.1% annually
Developed campground, organization camps, tours	+3.5% annually

TABLE III-18--Wilderness Visitor Capacity

[Source: Records of Beartooth District, Custer National Forest: Determination of Wilderness Carrying Capacity, October 1981.]

Management Unit	Camping PAOT[1]	Day Use PAOT[2]
East Rosebud	114	30
Phantom	28	15
West Rosebud	152	0 (100)[3]
Stillwater	236	125
West Fork Stillwater	86	20

[1]People at one time (PAOT) capacity at inventoried suitable campsites in unrestricted areas along travel corridors, using acceptable camping techniques, and on a daily basis.

[2]People at one time that the day use area can sustain without unacceptable biological impacts, on a daily basis during the summer season. Day use includes the area visited on day hikes, which generally extend no farther than four to six miles from the trailhead.

[3]The Mystic Lake day-use area is outside the Wilderness, but has a capacity of 100 people per day.

69 sites. There is also one private campground in the county; it has 20 sites (Montana Department of Fish, Wildlife, and Parks, 1978).

Two commercial dude ranches and three outfitters operate in Stillwater County. Use is primarily by people from outside the region in the summer and fall months. Fishing, horseback riding, and hunting are the principal activities offered. Besides the activities themselves, of great importance to the recreationist is the natural beauty of the surrounding area and the clean air, isolation from most manmade environment, and other more individual values (CDM, May 1981, p. 2.10-84). Seventy-five percent of Stillwater County residents surveyed state that they are satisfied with the outdoor recreational opportunities (Entercom, 1981). Of the Stillwater County residents surveyed, the activities the largest percentage participated in were driving automobiles, hiking or walking for pleasure, picnicking, or fishing (Entercom, 1981).

3. Community Recreation Resources

The City of Columbus has a swimming pool, 3 parks, 2 tennis courts, and 1 basketball court. The city's public works department maintains these facilities. Columbus also has 5 baseball fields, which are maintained by the teams, and a 9-hole golf course. The course is owned by the city but operated by an association. In addition, the high school gymnasium is open for public use during nonschool hours (Briscoe, Maphis, Murray and Lamont [BMML], 1981).

There are also organized athletic leagues in Columbus in summer and winter and a volunteer swimming instructor during the summer. Currently, there are no plans for expansion of these recreational facilities or programs (BMML, 1981).

Absarokee also has an outdoor swimming pool and one park with two tennis courts and a civic center. The park is maintained by volunteers from the Civic Club and a lifeguard is funded by the Lions Club. There are organized athletic leagues in the summer, including a swim program. Programs are supported by fund-raising efforts. There are no plans for expansion of programs or facilities (BMML, 1981).

Q. CULTURAL RESOURCES

A literature and archival review of existing cultural resources information for the Stillwater project area was completed by Western Cultural Resources Management during August 1980. This was followed by an on-the-ground survey of the mine, mill, and tailing site permit areas as well as the transportation corridor along FAS 419 between the mine and mill sites. A team of archaeologists walked parallel zigzag transects to locate, examine, map, photograph, sketch, and record all archaeological and historic structures, features, stone flakes, debris, or similar material as encountered. In addition, rock art (paintings or

drawings) within viewing distance of the study area were recorded. The report from this study is on file at the Department of State Lands and with the Forest Service (CDM, 1981).

Twenty-three cultural resource sites were located during the survey. Of these, nine were archaeological, thirteen historic architectural, and one contained both archaeologic and historic components. With the exception of one small cave, all archaeological sites are bison procurement or processing sites, stone rings, or cairns (heaps). Four areas of bison bone concentrations were located along the Stillwater River in association with a buffalo jump (cliff over which buffalo were driven). Stone rings and butchering areas were also noted at the jump. Two other bison processing and/or procurement areas were recorded elsewhere in the study area, as were other stone ring sites. The stone rings were probably habitation sites related to bison procurement. The stone cairns noted during the survey may have served as trail markers, caches (for food or weapons, perhaps), signal fires, horizon breaks for hunting purposes, or some other unknown function.

The cave site could have been used as an overnight campsite or cache, but is too small for group habitation. Evidence of butchered and burned bone fragments and local reports of aboriginal tools existing at the site suggest further research should be done.

The fourteen historic sites identified in the project vicinity included a wagon road, six sites associated with mining activity, and seven homesteads. The oldest sites date to the 1880s, and evidence the early attempts to exploit the mineral wealth of the region. Most of the homesteads were established from 1900 to 1920. These reflect the hope of the settlers for a more permanent residence and are predominantly related to agriculture and later mining activity.

One of the above sites, the buffalo jump, was identified in the 1975 Montana Historic Preservation Plan, which is an indication of its significance in Montana prehistory. In addition, the plan identified the site at old Nye City, in the vicinity of the project area. The recent survey, however, could locate no remnants of the town. Earlier reports speculated that the town could have been totally dismantled and moved, or that remains could have been buried under mine tailing from past operations.

One of the primary objectives of the cultural resources survey was to locate sites included on or potentially eligible for inclusion on the National Register of Historic Places (NRHP). Seven of the above archaeological sites may be eligible for the National Register, based on their potential to yield information on the prehistory of the area, and seven of the historic sites associated with mining and/or homesteading may be eligible for listing, based on their association with significant settlement and economic patterns, their illustration of construction techniques, and their potential to yield information. Discussions concerning the historical integrity and potential NRHP eligibility of these sites are underway between the Montana State Historic Preservation

Office, the Forest Service, the Advisory Council on Historic Preservation, and the Montana Department of State Lands. Five of these sites are located on national forest lands, including unpatented claims, but only two are within the project permit boundary. The remaining sites identified during the survey are on private lands.

R. AESTHETICS

1. Visual Resources

The project area falls in the Yellowstone Rockies Character Type (USDA, Forest Service, Visual Character Types Handbook); however, CDM (1981) further divided this character type into foothill and mountainous subtypes.

a. Foothill subcharacter type

The foothill subcharacter type, located in the northern portion of the project area, is comprised of gently rolling, grass-covered hills with irrigated pastures and flat valley bottoms. The dominant landscape features of the foothills area are the Stillwater and West Fork of the Stillwater Rivers, the associated deciduous riparian vegetation, and the oblong hill located north of Nye.

Within the foothill area, the majority of man-caused landscape alterations are the result of ranching and agricultural activities. These alterations include fence lines, farm support structures, ranch houses, irrigation ditches, haystacks, and farming equipment. Some rustic structures increase aesthetic appeal. Most of the ranching activities do not adversely affect scenic quality. The only major visual alterations are second home/condominium developments, such as Cathedral Ranch.

The proposed mill and tailing pond would be located in the foothill area. This area has received an existing visual condition (EVC) classification of 2 and 3 (Camp Dresser and McKee [CDM], 1981). This means that the appearance of the visual alterations of the natural landscape does not attract attention; that is, the natural appearance of the landscape is dominant.

The visual quality objective (VQO), based on procedures established by the U.S. Forest Service (1977) for the area is "partial retention" (CDM, 1981). That is, activities may introduce new form, line, color, or texture, but the changes must remain subordinate to the characteristic landscape.

The visual absorption capacity (VAC) of the area is relatively high (in comparison to the mountainous subcharacter type) due to the higher vegetative regenerative capacity and gentler slopes.

b. Mountainous subcharacter type

The mountainous subcharacter type, located in the southern portion of the project area, consists of steeply elevated, angular landforms that rise sharply from the Stillwater River Valley floor. The landforms are primarily vegetated with conifers, with aspen and birch in the drainages. The steepest slopes are comprised of talus or exposed rock faces.

Although the majority of the mountainous section is free of visual impact, mine access roads and past and current mine development in the Nye Creek, Verdigris Creek, and Mountain View Creek areas affects the scenic quality of these areas. The visual impact is most evident where roads cut across steep slopes and in the Verdigris Creek area due to substrate/vegetation color contrasts. Revegetation and rehabilitation programs have been initiated on some of the disturbed areas (CDM, 12-Month Baseline Report, Vol. II, 1981).

The proposed minesite is located in the mountainous section and has received and EVC classification of 4 to 5. The area where rehabilitation measures have been undertaken is EVC class 4, and the major disturbance areas due to past mining are ranked as EVC class 5. This means that the alterations to the natural landscape are easily noticed (Class 4) or obvious (Class 5).

The proposed minesite has received a VQO of retention. Therefore, the visual impact of any activity cannot be evident. Activities may only repeat the form, line, color, and texture frequently found in the characteristic landscape.

The proposed minesite has two VAC ratings: high VAC from the present access road down to the highway (FAS 419) and intermediate above the access.

2. Noise

No sound surveys have been conducted at the study area. Because it is a rural area with minimal traffic--250 average daily traffic count--and no major development other than activity at the proposed minesite, the sound levels are probably low. Ambient sound levels measured at a rural farm averaged about 40 dBA (decibels) (Eldred, 1974). It can be assumed that sound levels at the study area are similar.

CHAPTER IV

EVALUATION OF THE CONSEQUENCES OF THE PROPOSED ACTION

The Department of State Lands and the U.S. Forest Service analyzed the effects the proposed project would have on the social, economic, and natural environment. The analysis was guided by the concerns raised in the public scoping process, which are discussed in the introduction. This chapter discusses, by discipline, the environmental consequences of Anaconda's proposal and proposed changes to mitigate adverse impacts.

At the start, each discipline presents a summary of the significant consequences the project would cause. Following the summary is a detailed discussion of these consequences, as well as consequences of less significance. Each section ends with a list of "mitigating measures," or actions that could be taken to reduce or eliminate the project's projected impacts. The only mitigating measures listed are those that are not already part of the proposed project plan. The many measures that Anaconda Minerals Company has already formally committed to taking are discussed in chapter I.

The U.S. Forest Service has determined that Anaconda's proposed action is acceptable if mitigating measures required in this chapter are incorporated in the plan of operations. The Forest Service's preferred administrative alternative, selected from the four alternatives discussed in the introduction, is "approve a revised plan of operations with changes incorporated." The public's comments on this document will be considered in the final EIS. A notice of the Forest Service's decision will be included with the final EIS.

In keeping with an administrative process different from that of the Forest Service, the Department of State Lands does not identify a preferred option. A decision cannot be made sooner than 15 days after the publication of the final EIS, which will contain responses to public comments on the draft.

A. GEOLOGY

1. Summary of Impacts

Changes in the geologic environment from Anaconda's project would not be significant. The changes that would occur include (1) removal of the ore body, (2) construction of a waste dump at the minesite, and (3) filling of a small tributary valley to the Hertzler Valley with tailing.

A landslide of the material near Anaconda's minesite or failure of the crown pillar above Anaconda's underground excavations, although considered of low probability, would significantly affect the area.

2. Mining and Associated Disturbances

a. Removal of ore

Anaconda's mineral ownership (fig. III-2) and mine plan area constitute a small portion of the 28-mile-long zone of platinum-group metals (PGM). Therefore, mining this portion of the mineralized zone would have little long-term effect on the PGM reserve base of the Stillwater Complex.

b. Construction of a waste dump and tailing pond

Because the project would be a small underground mine, the waste dump created over 20 years of mining would be small, covering only 18 acres of the minesite. (See fig. IV-1.) Over half of the waste rock generated would be transported to the tailing area for use in reclamation after mining ceases. The remaining waste rock (324,000 tons) would be recontoured, covered with soil, and revegetated. (See Soils and Vegetation and fig. I-10.)

The waste dump would not adversely affect the geology of the area; the underlying geologic units are not geologically unique and placement of the waste dump would not preclude future mining under the dump.

The tailing pond would be 113 acres in size and contain 7 million tons of mill tailing. The tailing pond would fill one small ephemeral drainage. (See fig. IV-2.) The tailing pond would not adversely affect the geology of the mill/tailing site or underlying geologic units.

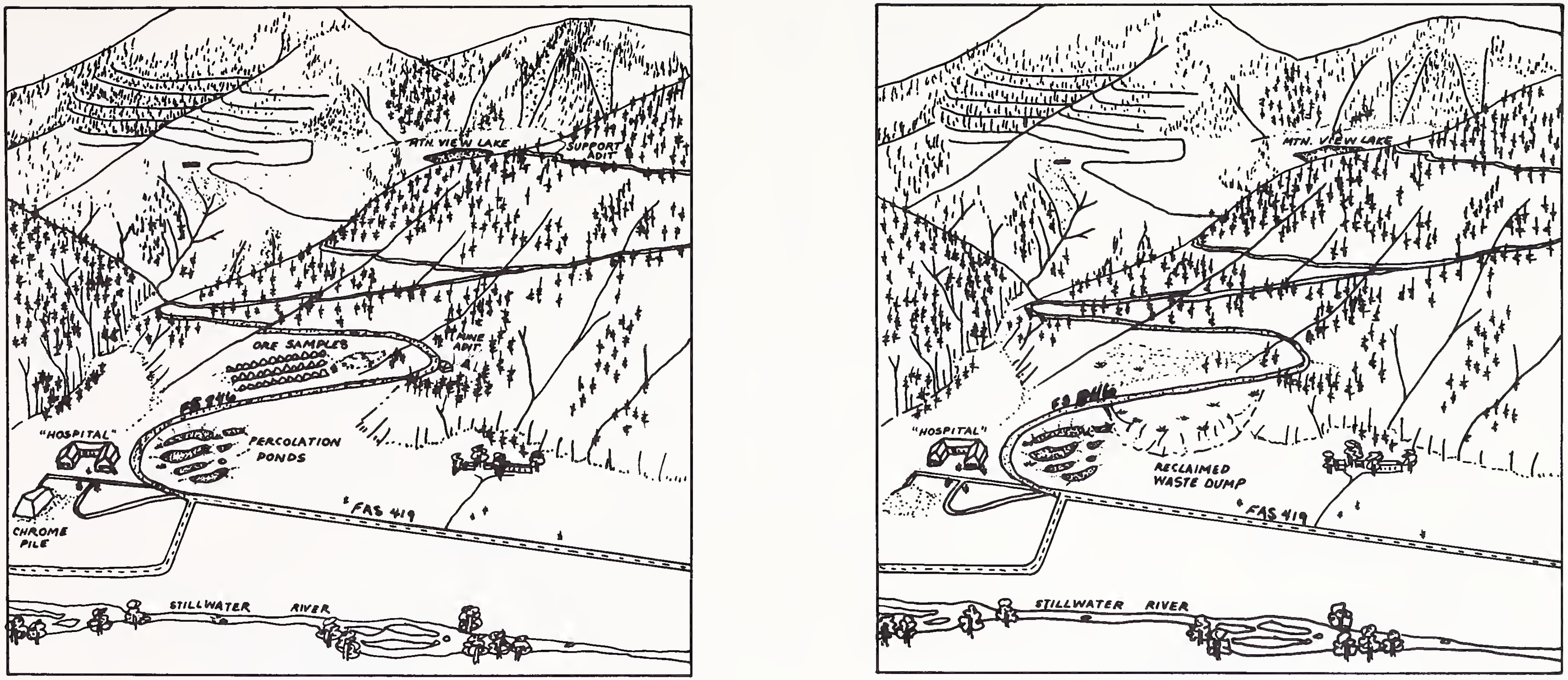
3. Geomorphology

Neither the construction of a waste rock dump near the adit nor construction of a tailing pond northeast of Nye would appreciably change the geomorphologic character of the landscape. The mine waste dump would be located outside the floodplain of the Stillwater River and would not cross any major tributary streams. The tailing pond would be built in two very small tributaries to the Hertzler Valley. This would create no adverse geomorphic effects, such as stream instability or sedimentation.

a. Erosion and sedimentation

1) Waste dumps

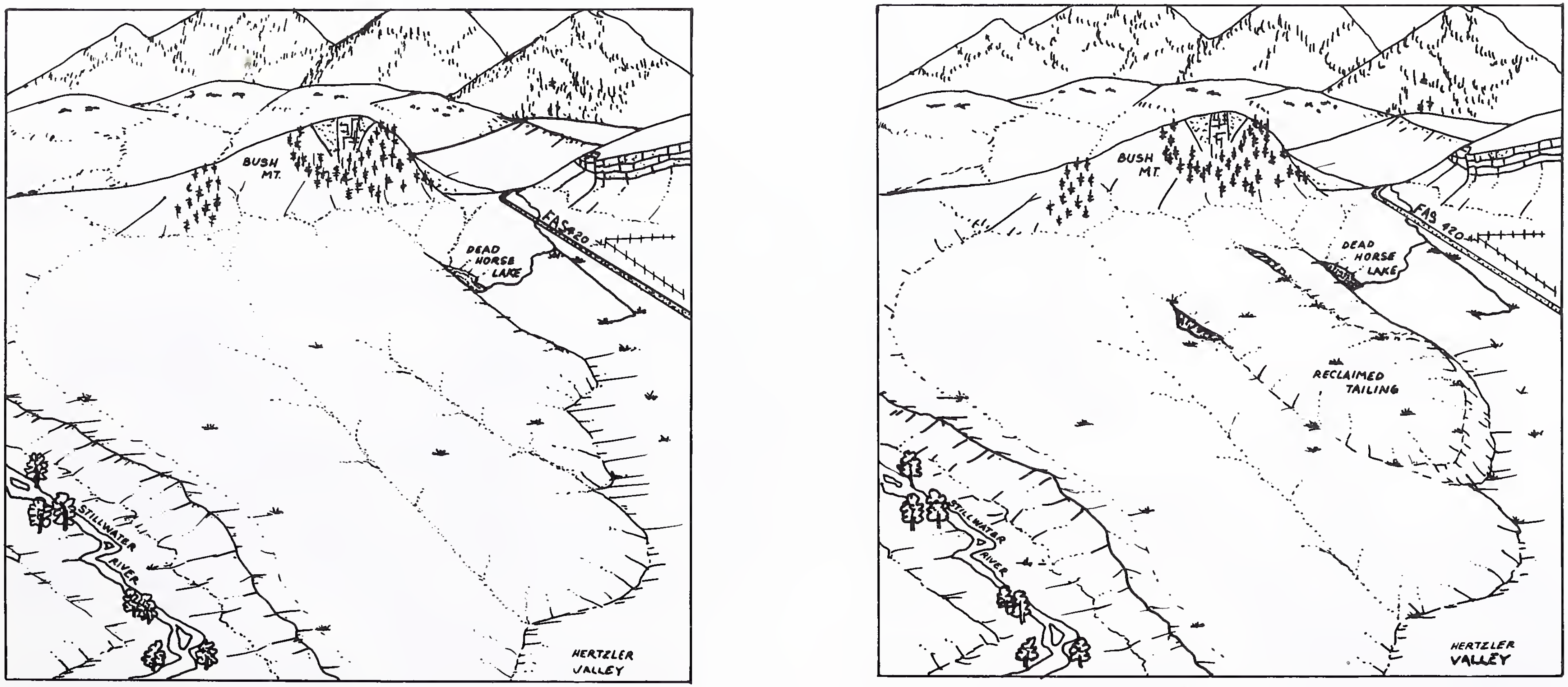
Within a few years after initial revegetation, the waste rock dump would probably have equal or better vegetative cover than existed prior to mining. (See Vegetation.) As such, erosion rates off the dump would be low in the long term--not high enough to adversely affect postmining land uses. For the first several months of initial revegetation, however, erosion rates off the dump would be moderate--above 5 tons/acre/year. Anaconda has committed to whatever erosion control measures would be necessary to keep erosion low enough to allow



PRESENT

AFTER RECLAMATION

FIGURE IV-1--Artist's Conception of the Mine Area Before Project Development and After Reclamation



PRESENT

AFTER RECLAMATION

FIGURE IV-2--Artist's Conception of Mill Area Before Project Development and After Reclamation

successful revegetation of all disturbed areas. Small problem areas may require special erosion control measures, such as jute netting.

Most if not all sediment eroded off the waste dump would accumulate at the toe of the dump and not reach the Stillwater River because the land between the dump and the river is nearly flat. Some of the finer eroded sediment could be carried by runoff water to the Stillwater River, but the amount is not expected to significantly affect water quality.

Waste rock taken from the upper support (1980-level) adit would be placed on top of the existing road. The waste rock would therefore not cause significant erosion or water quality problems.

b. Tailing pond site

The tributary drainage of the Hertzler Valley that would be filled with tailing is small, about 200 acres, and is not a significant contributor to the surface runoff of the Hertzler Valley or the Stillwater River. Damming of the tributary valley would therefore not change the channel shape or flow characteristics of either the Stillwater or Hertzler Valleys.

The mill would be located on a small knoll next to the tailing pond. It would not significantly change the geomorphic setting of the area.

As it is being built, the main tailing dam would be unvegetated and would be subject to high rates of erosion (above 50 tons per acre per year). Anaconda proposes to build a rock toe out from the tailing dam to catch runoff water, thereby preventing sediment from reaching the Hertzler Valley.

After Anaconda's milling operations cease, the tailing dam would be recontoured into the shape of a gentle dome. The recontoured tailing dam would be covered with salvaged topsoil. Initial erosion rates off the dam face would probably be high, and could approach 60 tons per acre per year (estimated using the Universal Soil Loss Equation) if measures were not taken to control erosion. To prevent the loss of seeds to erosion, Anaconda would have to implement temporary erosion control measures. Anaconda has not committed to any specific control measures because reclamation technology is quickly changing; however, Anaconda has committed in its permit application to use whatever erosion control measures are necessary to achieve successful reclamation. To date, the simplest and most cost effective method used in reclamation work is straw mulch. If one ton per acre of straw were crimped into the ground, the estimated erosion rate would drop to roughly 5 to 10 tons per acre per year. If two tons per acre of straw mulch were applied, erosion rates of 3 to 5 tons per acre per year could be expected. At this level of erosion, planted seed would have a good chance of successful germination and growth.

Sediment eroded off the dam face after reclamation would be deposited close to the base of the tailing dam. The Hertzler Valley is flat enough that runoff water from the tailing dam would quickly infiltrate into the ground, leaving the sediment behind. Sediment eroded off the tailing dam would not reach the Stillwater River.

4. Geologic Hazards

A variety of geologic phenomena could adversely affect Anaconda's project. At the minesite, landslides, rockfalls, earthquakes, failure of the crown pillar, and wall rock burst and scaling could pose a hazard. At the mill/tailing site, strong groundshaking caused by an earthquake could pose a hazard. The probability of any of these phenomena occuring is believed to be low and Anaconda's activities would not appreciably increase the chances that they might occur.

a. Minesite

1) Landslides

Anaconda's Minneapolis adit, upper support adit, and Forest Service Road 846 are within or close to two landslides. The probability of these two landslides occurring again over the next 20 years of mining is believed to be low (Robert Hinshaw and Larry Prinkki, U.S. Forest Service, Geotechnical and Field Investigations Leaders, Region I, Missoula, Montana, letter to Director of Region I Engineering, December 15, 1982). (See chapter III, Geology, Geologic Hazards.) If a landslide were to occur it could bury the adits, cause Anaconda's tunnels to partially collapse, and destroy buildings, roads, and timber In the worst case, a landslide could temporarily dam the Stillwater River. (Michael Burnside, Custer National Forest, Minerals and Geology staff, written report to Forest Supervisor, January 21, 1982).

The actual stability of the landslides cannot be determined with accuracy for two reasons: (1) the science of slope stability is not exact and (2) data or factors that influence these materials, such as subsurface extent of potentially unstable material, the amount and degree to which the material is saturated, and the cohesiveness and angle of repose of the material under different amounts of wetting, are unknown. More information would be needed before it would be known with reasonable accuracy how close these areas are to failure.

Natural phenomena, rather than Anaconda's work, would probably be the cause of any slope failures. Saturation of the landslides from excessive precipitation or heavy snowmelt, or strong ground shaking caused by an earthquake, could lead to their failure. A combination of both conditions would be the most probable cause for failure. Although the potential of these landslides and potentially unstable areas failing is remote, the Forest Service has required Anaconda to do further studies on these areas. (See Mitigation Measures.)

2) Rockfalls

Within Anaconda's mine permit boundaries several existing or potential rockfall areas have been identified. Anaconda's upper support adit is within one of the existing rockfall zones. The entrance to the upper support tunnel is located in an old landslide that contains numerous large boulders. As a precautionary measure, Anaconda has constructed a concrete retaining wall to stop rocks from rolling down onto the adit area. The concrete retaining wall would be able to stop most or all rock rolling down from the cut slope above the adit opening, but would not stop a landslide or slump from pouring over the retaining wall.

3) Earthquakes

Severe ground shaking caused by a large earthquake near the study area could cause slope falures, rock falls, and avalanches. Prediction of future earthquakes is currently impossible. Based on past earthquake activity in this region, the likelihood of an earthquake triggering landslides in the area is very low.

The 1959 earthquake at Hebgen Lake, an unusually strong earthquake for this region, is estimated to have produced peak particle velocity in the Stillwater Valley of 10 percent of gravity. No known landslides occurred as a result of this event, but several areas experienced rockfalls. Based on the limited earthquake information available, ground shaking stronger than that event is highly unlikely over the 20-year life of Anaconda's operations (Qamar and Breuninger, 1979). Therefore, the existing landslides or potential unstable material of the mine area would not fail during an earthquake.

4) Failure of the crown pillar above Anaconda's underground excavations

Anaconda's permit application states that a minimum 20-foot-thick crown pillar would be left between the underground excavation and overlying decomposed bedrock overburden. Anaconda provides engineering stress test data from the Minneapolis adit that shows a 20-foot crown pillar of competent material would not fail. Two problems exist with this approach, if the stress data are the sole criteria used to establish crown pillar thickness. First, the upper levels of the mine workings are closer to the surface and this weathered bedrock was less competent than that in the Minneapolis adit where the tests were taken. A second problem is that fracturing and faulting, which signficantly reduce the strength of the rock, were not considered in Anaconda's stress tests.

Anaconda prosposes to use rock bolts, timbers, and other methods to stabilize fractured, faulted, and unstable areas. These methods are acceptable short-term stabilization practices, but may not hold up over the long run. Rusting of rock bolts, rotting of support timbers, and weathering of the crown pillar over hundreds to thousands of years could cause the crown pillar to eventually collapse, potentially leaving a

hole 8 to 10 feet wide and over 1,000 feet deep (Mike Burnside, Geologist, U.S. Forest Service, written commun., April 2, 1982). (See Mitigating Measures.)

5) Wall rock burst and scaling

Rock burst is the sudden and violent failure of wall rock. The platinum-mineralized rocks Anaconda is mining are generally not susceptible to rock bursting. Anaconda to date has not encountered scaling (partially detached flakes of rock) beyond that normally found in underground mining (Jim Harrower, Anaconda Minerals Company, oral commun., April 16, 1982).

Miner safety is the responsibility of Anaconda, Anaconda's mining subcontractor, and the Occupational Safety and Health Administration (OSHA). OSHA representatives would periodically inspect the mine for safety compliance.

b. Transportation corridor

About 1½ miles north of the minesite, FAS 419 passes through a small area that was mapped as being potentially unstable and subject to rockfalls (Camp Dresser and McKee, 1980). Truck traffic between Anaconda's mine and mill site would cause slight, periodic vibrations; however, trucks have been hauling chromite ore to Absarokee for the last year without noticeable effects. Anaconda's trucks would be about the same weight, and therefore would probably not cause instability problems along the transportation corridor.

c. Mill/tailing site

The mill/tailing site lacks geologic features that would jeopardize the stability of the structures Anaconda proposes to construct. The material underlying the tailing pond and mill sites is composed of glacial deposits with slopes sufficiently flat to prevent landslides or slump failures.

The primary geologic hazard that could affect the stability of the tailing dam and pond is ground shaking caused by an earthquake. A large earthquake within tens of miles of the Hertzler Valley could cause the tailing dam to fail, but no major faults have been identified as being active within 40 miles of the mill/tailing site. (See chapter III, Geology, Geologic Hazards.)

Anaconda's design of the tailing dam would help prevent failures. The dam would be built using centerline construction. This would keep the crest of the dam centered over the starter core dam, a design preferred in earthquake-prone areas. In addition, the main tailing dam

would be constructed with the sand fraction of tailing. Finer tailing that could cause instability would not be used. Further, an underdrain pumping system would be incorporated into the dam design. This system would withdraw water from the tailing dam and thus significantly increase the dam's stability (Klohn, 1981, p. 11). In addition, Anaconda would install ten water-level measuring devices within the impoundment to monitor the area of saturation. This information would be used to determine the effectiveness of the underdrain pumping system in dewatering the tailing dam.

Tailing dams constructed in the manner Anaconda proposes have withstood even moderate groundshaking--peak ground accelerations of 20 percent gravity from earthquakes in the magnitude range of 6.5 to 7.0 on the richter scale--without failing (Finn, 1981, p. 77). Based on past earthquake activity in the region, the chances that groundshaking would exceed that level within the 20-year life of the milling operation is extremely low. (See chapter III, Geology, Geologic Hazards.)

In the unlikely event that the tailing dam failed, a portion of the dam and tailing could flow onto the grassland field within the Hertzler Valley. The tailing and dam material would cover the grassland of the Hertzler Valley and partially eliminate the vegetative productivity for at least several years. Natural revegetation of the failed material would partially occur within several decades. Anaconda would be responsible for reclamation work.

After the end of milling operations and during reclamation, the tailing impoundment would be regraded and revegetated. The tailing material would gradually become dewatered and would not fail under even the strongest ground shaking.

5. Other Mineral Resources

Mining by Anaconda of the platinum-palladium mineralized zone would not interfere with the extraction of the nearby chromite or copper-nickel mineralized deposits. Cumulative impacts of mining of one or both of these other mineralized areas while Anaconda is mining the platinum-group elements area would be difficult to predict. A brief discussion of potential cummulative impacts has been included in Chapter II (Uncertainties That Could Change Consequences).

Anaconda's activites in the Hertzler Valley would not preclude future mining of coal or extraction of oil and gas in the area.

6. Blasting Effects

Blasting in Anconda's underground mine probably would not destabilize surficial material and cause geologic hazards, since the level of groundshaking caused by blasting would be slight (D.C. MacIntyre, Forest Supervisor, Custer National Forest letter to Mr. Miles Keogh, Nye, Montana, September 16, 1977).

Surficial blasting during development work at the mine broke a few windows of a private residence within one-quarter mile of the Minneapolis adit. Blasting during active mining would be underground and would not structurally damage buildings.

The air blast created by underground blasting is reduced considerably by the time it reaches the adit opening, but at times might be detectable to nearby residents. Anaconda Minerals Company has committed in its Stillwater application to mitigate any significant public nuisances. If blasting were documented as being a nuisance the Department of State Lands could require Anaconda to reduce air blast effects.

7. Mitigating Measures

a. Landslide stability

The Forest Service will require Anaconda to hire a landslide stability expert to evaluate the old landslides and potentially unstable material near the minesite. The results of this investigation will be included in the Final Environmental Impact Statement. If the consultant's report indicates that the landslides could fail, additional studies and mitigating measures may be required of Anaconda. The following are possible additional requirements:

(1) Establish a permanent survey station to accurately measure, on a periodic basis, the location and elevation of survey stacks located within critical portions of the landslides. This would indicate when vertical or horizontal movement in the material has occurred.

(2) Establish a network of seismometers to record ground motion induced by blasting operations. The monitoring results would be analyzed and compared to past earthquake activity affecting the project area. Modification of Anaconda's blasting plans may be necessary if the results show that blasting is causing ground vibrations large enough to potentially destabilize the material.

(3) Control any ground water or surface water encountered in the mining operation so that additional water is not added to the existing landslides.

(4) Perform structural stability tests on the material.

(5) Perform tests and possibly monitor over a period of time the degree of saturation of the material. Pumping of water out of the potentially unstable material might be necessary to assure its stability.

(6) Perform physical and or geophysical testing of the material to determine the depth of potentially unstable material.

b. Crown pillar stability

To mitigate the potential hazard that a collapsed or subsided crown pillar would pose, the Forest Service would require Anaconda to detect weak areas and provide for a stable crown pillar that would remain for 100 or more years. Measures may include, but not be limited to, rock bolting, timbering, leaving thicker segments, and grouting. Should the crown pillar fail, the Forest Service would require the company to temporarily fence and post the area until permanent measures could be implemented. The holes or depression created by the crown pillar failure would have be bridged or filled so as not to pose a hazard.

c. Backfilling the adit entrances

The Forest Service would require Anaconda to backfill all three adit entrances and grade the fill material so that it blends with the surrounding landscape.

d. Sediment ponds at mine site

To prevent surface runoff from disturbed areas from reaching the Stillwater River, a sedimentation pond could be constructed; however, because runoff from the mine area would rarely, if ever, contain enough sediment to affect the Stillwater River, this mitigation measure does not appear warranted.

B. HYDROLOGY

1. Summary of Impacts

The proposed project would not significantly affect either present or future uses of ground or surface waters in the Stillwater Valley. Neither the mining nor mill/tailing operation would noticeably change the water quality of the Stillwater River or the quantity or quality of the ground water in the Hertzler Valley.

To date, discharge from Anaconda's exploration excavation has produced water of good quality--low in aciditiy and metals. Discharge from the underground mine workings is and will continue to be sent to percolation ponds, where the water infiltrates into the alluvial ground water system of the Stillwater River.

2. Surface Water

a. Minesite

Anaconda's mine headquarters and adit site would not interfere with surface runoff of any major drainage. The majority of disturbed areas would be over 600 feet from the Stillwater River. Most of the sediment eroded from disturbed areas would be deposited on the nearly flat terraces of the Stillwater River Valley. (See Geology, Geomorphology.)

Little if any increased sediment loads in the Stillwater River would result.

The Water Quality Bureau of the Department of Health and Environmental Sciences has jurisdiction over adit discharge directly into state waters. Anaconda now has a Montana Pollutant Discharge Elimination System (MPDES) permit for the Minneapolis adit, although no direct discharge is planned. Anaconda's percolation ponds are large enough to handle all anticipated mine adit discharge. (See chapter I.)

b. Transportation corridor

Some airborne particulate would be blown from the haul trucks traveling between the mine and mill sites (FAS 419 and 420). Most of the particles would be deposited on the surrounding landscape. The amount that would land in the river is unknown, but it would be a very small percentage of the total amount generated. (See Air Quality.) Some of the material deposited on the landscape would be washed into the river. In all, however, increases in suspended sediment levels in the river would not be detectable.

c. Mill/tailing site

Surface water of the Hertzler Valley or the Stillwater River would not be affected by the construction of the mill and tailing pond. During operation of the mill, no surface water would leave the tailing impoundment. A rock toe located downgradient from the main tailing dam would capture any runoff from the face of the tailing dam and prevent it from reaching the Hertzler Valley. In addition, the dewatering system incorporated into the tailing dam would keep water seepage of tailing water from reaching the Hertzler Valley. (See chapter I.)

Runoff water from the small drainage system (about 120 acres) above and south of the tailing dam would flow into the tailing impoundment. The tailing dam would be continually raised so that the dam would always be 7 to 9 feet above the top of the tailing. As such, the storage capacity of the impoundment would always be sufficient to accommodate runoff water generated by the area above the impoundment.

During reclamation, the tailing dam would be regraded into the shape of a dome. The only runoff from the tailing impoundment that would reach the Hertzler Valley would come from the northern half of the reclaimed dam. Erosion of sediment off the dam would not adversely affect the surface waters of the valley. (See Geology, Geomorphology.) The surface runoff from the reclaimed tailing dam would contain levels of metals and other substances well below toxic levels. The reclaimed tailing area would permanently dam a small drainage system of less than 100 acres. The loss of this surface water to the Hertzler Valley would not be significant.

Based on preliminary design specifications, the tailing dam and tailing impoundment would probably remain stable throughout the life of the operation. The surface waters of the Stillwater River would not be in significant danger because of construction of the tailing dam. (See Geology, Geologic Hazards.)

3. Ground Water

a. Minesite

Mining would cause localized ground water flow changes, but no significant hydrologic impacts. Anaconda's exploration activities may have been responsible for reducing the flow from a spring that was used as the main water supply by the Hjelvik residence (located 500 feet east of the Minneapolis adit). Anaconda has replaced the Hjelvik water supply with water from the company's own wells (Mrs. John Hjelvik, oral commun., April 20, 1982). Anaconda's mine development would dewater a slightly larger area of bedrock. Even so, no springs in the Stillwater Valley other than the spring that supplied the Hjelviks would be dewatered by the localized ground water flow changes.

Anaconda may need up to 100 gallons per minute (gpm) of water at the minesite for mining and mine personnel. This quantity of water would be insignificant (much less than 1 percent) of the total ground and surface water flowing through the Stillwater hydrologic system. Most of the water needed for drilling would probably come from ground water seepage entering the mine. To supplement this, Anaconda has drilled an alluvial ground water well within the permit area, which is capable of supplying the water needs of the mine offices and change rooms. Although no additional water sources are anticipated, Anaconda has mentioned that additional water from Mountain View Lake may be needed in the future (Jim Harrower, Anaconda Minerals Company, April 22, 1982). To use water from Mountain View Lake, Anaconda would have to ammend its permit application.

Based on the high quality of the water now leaving the exploration adit, mining of platinum-group metals is not expected to deteriorate water quality in the alluvial ground water system beneath the mine area or water in the Stillwater River. (See chapter III, Hydrology, Ground Water.)

The company would biannually monitor the ground water quality from three observation wells located down gradient of the percolation ponds. (See fig. I-4.) The company would continue monitoring for the period of time required by the Department of Health and Environmental Sciences or the Department of State Lands. The results would be given to the Department of Health and Environmental Sciences and the Department of State Lands. (See chapter I.) Should any water quality problems develop, Anaconda would be required to alleviate them.

Miners could encounter high pressure ground water zones that could cause Anaconda to abandon a portion of the mineralized zone. This would shorten the life of the mine. Johns-Mansville had to abandon its West Fork adit because of high pressure water. (See chapter III, Hydrology, Ground Water.)

c. Mill/tailing site

During the life of the project, two sump wells would capture most of the estimated 100 gallons per minute of water seeping through the tailing pond. The captured water would be pumped back and recycled through the milling circuit. (See chapter I.) Only a small quantity of water coming in contact with the tailing would reach the Hertzler Valley. Water infiltrating through the tailing pond and reaching valley ground water is expected to be of equal or better quality than most of the ground water found in the valley. (See table IV-1.) The reason for this is that the mill process removes nearly all metals that could be considered toxic, and the milling reagents are either largely recycled or are not considered toxic. (See appendix 2.)

Much of the mill water would be recycled by the water reclamation barge and underdrain systems. (See chapter I.) Therefore, the amount of fresh make-up water needed to run the mill would be small, less than 100 gpm. This water would come from wells located within Anaconda's permit area. The withdrawal of this water would not significantly change the overall water balance of the Hertzler Valley.

Very little water would actually move through the tailing impoundment once it is reclaimed. Little precipitation would infiltrate all the way through the tailing; evaporation and plant uptake would consume nearly all available water. In addition, because the drainage area above the tailing pond is small and the glacial material underlying the drainage is porous, very little surface runoff will be dammed by the reclaimed tailing pond. The net amount of water moving through the tailing would be small in comparison to the amount of ground water moving through the Hertzler Valley. In total, changes in availability and quality of ground water near the mill/tailing site would be insignificant.

C. SOILS

1. Summary

Impacts on soils resulting from the Anaconda Stillwater Project would not be significant, if mitigating measures at least as effective as those discussed at the end of Vegetation are implemented. However, there would be unavoidable soil impacts. Disturbance of the soil profile and storage would greatly reduce soil microorganism populations and organic matter content, disrupt pore continuity, and break down soil structure. Because of these impacts, the reclaimed areas would probably be more sensitive to mismanagement and drought than before disturbance,

TABLE IV-1--Comparison of Test-Run Mill Tailing Water with Drinking Water Criteria and with Existing Ground Water of the Hertzler Valley
(All values are in miligrams per liter unless specified.)

Constituents	Water Quality Criteria[1]	Tailing Pond Water[2]	Mill Test Water[3]	Hertzler Valley Observation Wells: H1A (Valley fill)	H2 (bedrock)	H3 (valley fill)	H4 (valley fill)	H5 (valley fill)	H6 (valley fill)	H7 (bedrock)	H8 (valley fill)
pH		7.8-8.1	7.7	7.4	7.2	7.8	7.5	7.2	7.4	8.4	7.6
Specific Conductance (millmhos/liter)		650		128	207	201	265	286	225	1223	205
Dissolved Solids (calculated)	500[4]	495	545	139	691	151	165	175	143	980	140
Total Alakalinity ($CaCO_3$)		120	165	110	372	110	130	139	108	404	99
Bicarbonate		146	201	134	450	134	157	168	131	489	120
Aluminum	0.05	.1		1.3	38.1	0.5	5.8	3.4	0.9	373	0.53
Arsenic	0.05	0.005	0.01	0.005	0.043	0.005	0.008	0.007	0.005	0.507	0.004
Barium		0.05		0.2	0.9	0.2	0.2	0.2	0.2	8.0	0.2
Boron	1.0		0.02	0.1	0.5	0.1	0.1	0.1	0.1	0.5	0.1
Cadmium	0.004	0.001		0.010	0.010	0.010	0.010	0.010	0.010	0.020	0.010
Chromium	0.05	0.005		0.020	0.033	0.017	0.027	0.020	0.017	0.413	0.017
Copper	0.02	0.019	0.044	0.043	0.127	0.040	0.070	0.043	0.040	0.430	0.040
Iron	0.3(4)	0.073	0.033	1.343	38.300	2.050	5.433	5.000	1.003	334.000	1.955
Lead	0.05	0.03		0.318	0.217	0.008	0.248	0.050	0.032	0.486	0.228
Manganese	0.05	0.015	0.021	0.067	0.400	0.073	0.143	0.100	0.047	4.253	0.030
Mercury	0.002	0.0005		0.00010	.00013	0.00013	0.00183	0.00200	0.00120	0.00213	0.00017
Molybdenum	0.01		0.01	0.005	0.007	0.005	0.005	0.005	0.005	0.032	0.005
Nickel		0.013		0.043	0.060	0.060	0.053	0.050	0.040	0.413	0.040
Silver	0.003	0.005		0.020	0.053	0.020	0.030	0.050	0.020	0.097	0.017
Sodium		72	41	7.1	220.0	11.2	9.4	21.7	9.6	373.3	7.6
Sulfate	250[4]	201	168	14.0	2782.0	21.0	17.0	21.7	12.0	404.0	14.0
Zinc	0.1	0.027	0.42	0.093	0.270	0.073	0.380	0.130	0.070	1.353	0.093

[1] DSL and Kootenai National Forest, 1978, p. 314. Represents lowest concentration that has been shown to have adverse impacts; or maximum recommended concentrations for drinking water, stock water, long-term irrigation and maintenance of fresh-water aquatic life.
[2] Maximum values taken from three analyses done on tailing produced in mill process test runs.
[3] Tuscon Arizona tap water used in mill test run.
[4] Recommended values that are not necessarily harmful to human health if exceeded.

for perhaps several decades after mining. There would also be unavoidable loss of soil from wind and water erosion.

2. Minesite

Construction of a chromite mill and associated facilities in the early 1940s destroyed most of the soil in the area immediately south and southeast of the Minneapolis adit. As a result, only about 8.6 acre-feet of salvageable soils exist to reclaim 23.6 acres of disturbance area, providing an average cover depth of about 4.5 inches.

a. Cut and fill slopes

Anaconda would spread soil over cut and fill slopes and revegetate them with a permanent seed mixture to maintain vegetative cover throughout project construction and operation. Therefore, no long-term soil storage would be required. Upon project completion, the slopes would probably be stable and therefore would not be redisturbed.

Wind and water erosion have the greatest potential to create reclamation problems on the steep, short cut slopes, especially during the first few growing seasons. Anaconda has proposed a number of erosion control measures (e.g. jute netting, mulch) that would minimize erosion until a vegetative cover is achieved. In addition, if significant erosion occurred over the 20-year life of the project, Anaconda would take corrective measures as problems develop, such as filling gullies and revegetating eroded areas.

Where premining surveys show that a talus effect is more in keeping with the natural landscape, the cut or fill slopes would be left bare, rather than spread with soil and revegetated.

b. Waste rock dumps

The lower waste rock dump would be built up over the 20-year life of the mine in an area south of the Minneapolis adit. About 426.7 acre-feet of waste rock would be removed from the adit during this period (swell factor included). All would initially be placed at the waste-dump site; however, during final reclamation, about 226.1 acre-feet (53 percent) would be hauled to the tailing pond site to "cap" the tailing, reducing the volume at the waste dump near the adit to about 200.7 acre-feet. This would be regraded and prepared for final reclamation. Because over half of the waste rock would be hauled away, the final dump slopes would be reduced (to about 13 to 15 percent at the steepest), and the potential for successful reclamation enhanced.

Anaconda has amended its exploratory license to include a reclamation plan for the upper support adit and associated disturbances. (The upper adit is termed the "1980 adit" because it is located at 1,980 meters of elevation.) This reclamation plan was approved by the Department of State Lands (DSL) and the U.S. Forest Service in 1981 (Custer National Forest Environmental Assessment Report, June 1, 1981).

The company has also amended its application for an operator's permit to include this plan. The current exploratory license allows the company to raise the level of the existing road near the mouth of the adit by spreading waste rock. The exploratory license stipulates that the final grade of the road must be less than 9 percent. The waste dump is not expected to significantly expand in size since the waste is from a support adit (air shaft), and not a development adit. However, if an operating permit is granted and Anaconda finds that its operation requires a larger dump area, it would have to apply to DSL and the Forest Service for a permit amendment.

1) Soil quantity and quality

Anaconda is proposing to veneer the faces of the lower waste dump with 4.5 inches of soil. Most of the available soil in this area is actually subsoil, left from earlier disturbances. This soil ranges from sandy loam to sand, contains between 30 and 70 percent coarse fragments, and appears to contain little organic matter. Based on field observation, the soil differs little from the waste rock it would cover.

The water- and nutrient-holding capacity of the soil as well as of the underlying waste material would be low. This would result from the coarse texture and lack of organic matter of both materials, and this could limit reclamation success. Water- and nutrient-holding capacities would remain low until organic matter increased from years of vegetative growth. The low water-holding capacity would be partially mitigated by the semi-humid climate of the area; however, most of the precipitation occurs during April, May and June. Therefore, for the remainder of the season, droughtiness could become an important factor in hindering successful revegetation.

Because of the low nutrient-holding capacity of the soil and waste material, Anaconda proposes to add mineral fertilizers to the soil during reclamation. This would probably be necessary on an annual basis for several years, since most of the nutrients not used by the plants in a given growing season would probably be lost through leaching.

For the 1980 adit area, reclamation would consist of leaving most of the disturbed site as a talus slope and roadbed, which would blend in with existing features in the surrounding area. The company has proposed to revegetate parts of this disturbance area where feasible, in keeping with the natural landscape. Revegetation would be difficult, since no salvageable soil existed in the area prior to disturbance. The current reclamation plan calls for additional soil to be trucked in if necessary; however, the plan does not state the source of the soil. Therefore, soil quality cannot be determined.

The company would probably have to use the coarse-textured material found at the adit entrance to supplement soil volumes. This coarse material contains little, if any, organic matter. Although precipitation is probably greater than at the Minneapolis adit dump, most falls in the spring and early summer, and would not be retained throughout the

growing season. Late season dryness would place added stress on plants during reclamation. Research by Brown et al. (1976) has indicated that the lack of water during the growing season on high elevation disturbances is one of the most important limits to survival of first-year vegetation. They conclude that at least part of this water stress stems from the low water-holding capacity near the surface of coarse, rocky mine waste.

2) Waste rock chemistry

Because the depth of respread soil would be shallow at the Minneapolis adit (lower) dump, the chemical quality of the underlying waste rock would figure significantly in revegetation success. Table IV-2 shows a chemical analysis of the waste rock by rock type of representative samples. The table, presenting values derived from the EP Toxicity Test Procedure (Federal Register, 1980) shows "worst case" results. (The EP Toxicity Test subjects waste rock to 24-hour leaching with acetic acid at pH 5.0--conditions far more severe than those that would be found at the waste dump site.) The table shows that all chemical characteristics are well below levels at which they could be harmful to plants. The waste rock material thus would not chemically impede revegetation.

Waste rock chemistry at the 1980 adit is unknown: no samples were analyzed from this site. However, it is assumed that the waste rock chemistry here is similar to that from the Minneapolis adit. If the waste rock were toxic, the company would be required to alleviate any problems that occurred.

3) Erosion

Erosion at the lower dump site is expected to be moderate during the initial few years after reclamation and low from then on. This is providing the company exercises optimum erosion control and management practices. (See Geology, Geomorphology.)

Any moderate loss of soil in the initial few years would probably be insignificant, because the quality of the soil proposed for respreading on the waste dump is not much different than the waste material itself. However, if erosion were allowed to continue, vegetation would be adversely affected in the long term.

Erosion rates on the waste dump at the 1980 adit site cannot be estimated, since final dump configuration and waste size fractions are unknown. If this waste dump were to ultimately consist of talus-sized fragments, no erosion problems would be expected. However, if this waste dump were to contain significant amounts of finer (soil-sized) materials, erosion could become a problem until control measures are taken. Anaconda has committed to any measures necessary to control erosion in the proposed permit area.

TABLE IV-2--Chemical Analysis of Mine Waste Rock*

		ROCK TYPE				
		Gabro	Norite	Anorthsite	Diabase Dike	State Suspect Level
PARTS PER MILLION	Arsenic	< 0.005	< 0.005	< 0.005	< 0.005	**
	Barium	< 0.1	< 0.1	< 0.1	0.1	**
	Cadmium	< 0.001	< 0.001	< 0.001	< 0.001	> 1.0
	Chromium	< 0.005	< 0.005	< 0.005	< 0.005	**
	Lead	0.02	< 0.01	< 0.01	< 0.01	> 20.0
	Mercury	< 0.0005	< 0.0005	< 0.0005	< 0.0005	> 0.5
	Selenium	< 0.005	< 0.005	< 0.005	< 0.005	> 2.0
	Silver	< 0.005	< 0.005	< 0.005	< 0.005	**
	Nickel	0.11	0.09	0.22	0.38	> 1.0
	Copper	0.11	0.11	0.18	0.39	> 40.0
	Iron	7.4	7.8	19.0	44.0	**
	Manganese	0.86	0.41	0.40	0.91	> 60.0
	Zinc	0.10	0.05	0.06	0.07	> 40.0

* EP Toxicity Text Procedure; Federal Register, May 19, 1980, v. 45 no. 98, pp. 33127-33129, Appendix II.

** State suspect levels for these elements have not been assigned; however, the following have been proposed:
arsenic => 2.0 parts per million (ppm);
chromium =>8.0 ppm

3. Mill Site

After all structures are removed and service roads are ripped and contoured, Anaconda would replace soil to a proposed average depth of 18 inches. This may be difficult, however, since the permit area poses serious limitations to soil salvage (as shown in table IV-3). The most serious in the mill site area is the quantity of stones and boulders. To attain the proposed amount of cover soil, Anaconda plans to salvage deeply in areas with fewer stones and boulders. If this fails to yield the proposed 18 inches, the company would sift stony material to obtain additional soil.

In addition to the limitation posed by stones and boulders, the majority of the soils in the mill area are high in gravel. If concentrated gravel areas occur after the soil is respread, low water- and nutrient-holding capacity could result; however, the amount of fines present would probably mitigate much of this potential problem.

Erosion is not expected to be a problem in the mill area due to the relatively level topography of the proposed reclaimed mill site.

4. Tailing Disposal Site

The tailing pond would be reclaimed when all operations ceased. Waste rock would be hauled from the waste dump and placed on the 113-acre tailing impoundment surface to a depth of 2 feet. The stability provided by the waste rock cap over the tailing would allow soil replacement by heavy machinery during the summer months. The entire capping process may take 6 months to 1 year, with reclamation proceeding concurrently with the capping.

Both the impoundment area and the associated disturbance area would be veneered with soil to an average depth of 18 inches. The same limitations on soil salvage present at the mill site--stones, boulders, and gravel content--are present here.

The chemistry of the tailing is not expected to hamper reclamation. Tests have shown that even by drinking water standards the leachate from the tailing is not unfavorable.

a. Erosion

Erosion within the tailing impoundment area is not expected to be a problem, providing the tailing are kept moist until reclamation is complete.

On the face of the tailing pond dam, erosion would probably occur at a rate greater than the rate of soil formation during the initial few years of reclamation. Anaconda has committed in its permit application to keep soil loss at a minimum until adequate revegetation is achieved; however, no specific erosion control measures are mentioned. DSL estimates that application on the face of the tailing pond dam of at

least 2 tons of straw mulch per acre, crimped into the soil, would provide adequate soil loss protection until permanent vegetation cover is achieved. A permanent vegetation cover of about 60 percent ground cover and 25 percent canopy cover would be necessary to keep the rate of soil loss below the rate of soil formation. (See Geology, Geomorphology.)

5. Soil Stockpiles

Most of the salvaged soil would be stockpiled for the life of the operation (about 20 years). To prevent soil loss from wind and water erosion, the company would revegetate the stockpiles with a mixture of native and introduced plant species.

a. Effects of soil disturbance and storage

The adverse effects of soil disturbance and prolonged storage in stockpiles have been documented in the literature (Reeves et al., 1979; Miller and Cameron, 1976; Davidson, 1976). Impacts associated with this procedure are largely unavoidable. They include loss of soil microorganisms, breakdown of organic matter and soil structure, and a decrease in soil fertility. Because of these impacts, Anaconda intends to apply fertilizer to areas respread with soils.

6. Mitigating Measures

Because the impacts on soils and vegetation are closely linked, mitigating measures for both are discussed together, at the end of Vegetation.

D. VEGETATION

1. Summary of Impacts

All existing vegetation in the proposed disturbance area (about 165 acres) would be destroyed as a result of the mining, milling, and tailing pond operations. Anaconda's reclamation plan would be moderately successful overall; low water- and nutrient-holding capacity of the soils and waste material, as well as moderate to locally severe wind and water erosion, could hinder revegetation in some areas. Anaconda could improve its proposed postmining species list by adding additional plants that would enhance wildlife habitat--the final reclamation goal.

2. Potential Revegetation Problems

a. Mine area

A number of rectifiable revegetation problems are anticipated for both the Minneapolis adit and the 1980 adit mine areas. These areas have limited soil available for reclamation of the waste dumps and associated disturbances. The soil that is available, as well as the

TABLE IV-3--Soil Mapping Units of the Proposed Permit Area Rated for Suitability as a Source of Salvageable Soil

SOIL MAPPING UNIT	SOIL RATING AND DEPTH (INCHES) GOOD	FAIR	UNSUITED	LIMITATION[1]
Cryofluvents-Cryaquolls complex, flooded, 0-4% slopes	--	--	0-84	excess gravel and high watertable
Lolo cobbly loam, 0-4% slopes	0-31	--	31-84+	excess gravel and watertable
Nesda gravelly sandy loam, 0-4% slopes	0-15	--	15-84+	excess gravel and watertable
Work loam, 2-8% slopes	0-28	28-104	--	clayey subsoil
Sebud stony loam, 4-25% slopes	--	--	0-84+	stones, boulders
Sebud stony loam, 25-50% slopes	--	--	0-84+	stones, boulders, steep slopes
Tomy stony sandy loam, 4-25% slopes	--	0-34	34-84+	stones, boulders
Hilger-Castner-Rock outcrop complex, 25-60% slopes				
Hilger part	--	0-19	19-84+	stones, excess gravel
Castner part	--	0-11	11-16	stones, sandstone bedrock
Winkler-Hilger-Rock outcrop association, steep slopes				
Winkler part	0-23	23-84	84+	stones, low pH
Hilger part	--	0-19	19-84+	stones, excess gravel

Rock outcrop-Stuck association, steep slopes				
Stuck part	--	0-14	14-26	excess gravel, bedrock
Rock outcrop-Castner association, steep slopes				
Castner part	--	0-11	11-16	sandstone bedrock

[1]Limiting characteristics refer to "fair" or "unsuited" soil rating columns only--not the "good" column.

waste material proposed for plant growth medium, is coarse-textured and contains little or no organic matter. Water-holding capacity would thus be low. Plant growth could be hindered due to lack of moisture, especially during the latter, drier part of the growing season. The soil's ability to store moisture through dry periods is important to plant growth, especially during the initial years of reclamation. The soil and waste material proposed for use in reclaiming these areas would not effectively store water for many years, until the plants add organic matter to the soil naturally. (See Mitigating Measures.)

Nutrient-holding capacity would also be low in the soil and waste material. Moreover, plant nutrients added to this coarse-textured material would probably not carry over to the next growing season. Therefore, unless the company fertilized annually, vegetation cover could deteriorate. (See Mitigating Measures.)

Anaconda has been successful so far in reclaiming the old chromite mill area (at which reclamation began in 1979), despite the absence of soil, the coarse texture of the waste material, and the lack of organic matter. However, fertilizer is added annually and the area is irrigated during parts of the growing season. Future reclamation areas would also be fertilized when necessary and irrigated where possible.

The company should avoid irrigating reclamation areas after about 2 to 3 years. Prolonged irrigation would cause a change in the plant communities present--from drought-tolerant to intolerant species. If this were to occur, the drought-intolerant species established during the irrigation years would lose vigor and die after irrigation is terminated. It is desirable to establish vegetation communities in reclamation areas that would attain good growth and reproduction after the area is abandoned.

Wind erosion is currently the overriding hindrance to ongoing revegetation at the Minneapolis adit mine area (Bart Richards, Anaconda Minerals Company, oral commun., January 30, 1982). This may continue as a problem for future revegetation at the 1980 adit area. Keeping the seed in the ground is difficult, even using erosion control measures. Apparently, the solution is timing: during the high precipitation season (April through June), the winds in the Stillwater area tend to decrease. If the seeds are planted just prior to this season, a good percentage of them germinate and the plants become partially established before the winds pick up again later in the summer.

The timing method has proven successful with Anaconda's reclamation of the old chromite mill area. The old mill area lies adjacent to the Minneapolis adit and is being reclaimed by Anaconda. Some small areas of sparse vegetation persist due to wind erosion. These areas would have to be reseeded or, if small enough, they will become naturally seeded from adjacent vegetation. In any case the results of the old mill site are promising.

Water erosion could also be a hindrance to reclamation. This would be especially true on some of the steeper areas, such as the slopes of the proposed waste dumps and the cut slopes for the access roads. According to its permit application, Anaconda would use any control method necessary to keep erosion at a minimum and allow vegetation to become established. Preliminary calculations show that the application of 2 tons of straw mulch per acre, crimped into the soil, would temporarily reduce erosion rates on the dump slopes so that seed exposure and loss would be limited, increasing the chance of vegetation success. (See Geology, Geomorphology.) However, this measure would not be appropriate for all slopes because of equipment limitations. The use of a more extreme erosion control measure, such as jute netting, may be necessary on some of the steeper cut slopes along the access roads. Channel or gully erosion could initially occur in places; however, this could be corrected before jeopardizing revegetation success. Talus slopes should be left along cut slopes where they would blend in naturally with adjacent undisturbed areas. (See Mitigating Measures.)

b. Mill and tailing pond area

Because Anaconda has committed to salvaging 18 inches of soil for reclamation of the mill and tailing pond area, water- and nutrient-holding capacity are of less concern here than in the mine area. However, fertilizer (and possibly some organic matter) would have to be added initially, since stockpiling soils for 20 years would cause some soil degradation. (See Soils.) As in the mine area, wind erosion may hamper reclamation. As long as seed planting is timed correctly, no major revegetation problems are expected.

The major factor limiting reclamation in the mill and tailing area would be erosion on the face of the tailing-pond dam. Implementation of the mitigating measures discussed at the end of this section and in Geology, Geomorphology would keep initial erosion rates at a minimum, allowing successful plant establishment. According to rough calculations, vegetation density would have to approach about 60 percent ground cover and 25 percent canopy cover to keep the erosion rate less than the rate of soil formation. Under intensive management by the company, this could be achieved several years after initial planting.

Channel or gully erosion would probably still occur in places, initially causing minor vegetation disturbance. Quick corrective action by the company would ensure that no major vegetation losses occur.

3. Proposed Revegetation Species

Anaconda's proposed revegetation species, given in table IV-4, are for all reclamation areas. Most of these species are expected to attain moderate to good growth on the lower mine area and the mill and tailing area.

As shown in table IV-5, of the premining vegetation types proposed for disturbance, Stony Grassland encompasses the largest acreage. All

TABLE IV-4--Proposed Revegetation Species for All Disturbance Areas

Common Name	Scientific Name	Approximate Seed Rate[1] (Pure Live Seed)
bluebunch wheatgrass	*Agropyron spicatum*	4-5 ppa[2]
Western wheatgrass	*Agropyron smithii*	4-5 ppa
pubescent wheatgrass	*Agropyron trichophorum*	4-5 ppa
sheep fescue or Idaho fescue	*Festuca ovina* or *Festuca idahoensis*	3-4 ppa
Canada bluegrass	*Poa compressa*	3-4 ppa
green needlegrass	*Stipa viridula*	3-4 ppa
silky lupine	*Lupinus sericeus*	0.5 ppa
fringed sagewort	*Artemisia frigida*	0.5 ppa
yellow sweetclover	*Melilotus officinalis*	2-3 ppa

[1] Depending on the availability of seed, the rate of seeding any particular species may have to be modified.
[2] pounds per acre

TABLE IV-5--Vegetation Types Proposed for Disturbance in the Permit Area

	Vegetation Type[1]	Acres to be Disturbed
Mine Site:	Open Forest-Meadow Understory	12.0
	Open Forest-Rocky Understory	2.2
	Disturbed[2]	9.3
Mill Site:	Drainage Bottomland	0.7
	Sagebrush Shrubland	0.7
	Stony Grassland	8.5
Tailing Site:	Sagebrush Shrubland	9.1
	Stony Grassland	122.8
	Cultivated Hayland	0.5

[1] Vegetation types are described in detail in Chapter II.
[2] The disturbed area at the minesite consists of roads, structures, storage areas, and ore and waste rock piles associated with the current exploratory operation as well as part of the reclaimed former chromite mill site.

of this type occurs in the mill and tailing area. As discussed in chapter III, this type is dominated by perennial forbs and grasses. Although the proposed revegetation mixture includes a number of grasses and two native forbs, the mill/tailing reclamation would be enhanced by additional forbs and some warm-season grasses. This would improve wildlife habitat, Anaconda's ultimate reclamation goal. With time, forbs and warm-season grasses would invade the area; however, this process would be hastened by the establishment of colonies, or "islands," of forbs and warm-season grasses. Since these types of plants are less competitive than the cool-season grasses (such as the wheatgrasses), small select areas could be set aside for forbs and warm-season grasses only, allowing them to become established and compete with adjacent cool-season species. Seeds for species not available commercially could be collected locally, or plugs (transplants) could be used.

Shrubs are currently located within the Open Forest-Meadow Understory, Open Forest-Rocky Understory, and Sagebrush Shrubland premining vegetation types, of which small but significant areas are proposed for disturbance. (See table IV-5 and Chapter III, Vegetation.) These shrubs include species such as mountain ninebark, horizontal juniper, common juniper, and skunkbush sumac. Addition of shrubs to the proposed revegetation list would improve wildlife habitat on the reclaimed areas. As with the forbs and warm-season grasses, shrubs would have a better chance of survival if they were planted (or better yet, transplanted) in colonies on select areas. Such areas would not have to be extensive on the reclamation area to allow for natural seeding of other shrub communities. Transplanting local shoots or natural seedlings collected from undisturbed areas would allow the greatest chances of survival.

4. Reclamation at the 1980 adit

As discussed in Soils, reclamation of the 1980 adit area would consist of leaving most of the site as a talus slope and roadbed. However, the company has proposed to revegetate portions of the disturbance area to control erosion and mitigate visual impacts.

Revegetation at the 1980 adit area would be more difficult than at the lower disturbance areas, especially with the proposed seed mixture and seeding rates. Brown et al. (1976) and Brown and Johnston (1978 and 1979) have found that a number of factors must be considered to attain revegetation success at higher altitudes.

The research has found that the application of organic matter, fertilizer, and sometimes a surface mulch is essential to alter the conditions of the coarse waste material. If the area is to be seeded, it should be done in the fall, since accessibility is usually poor in the spring and early summer. By the time the area is usually accessible, drying of the soil has begun, and the requirements of most native species cannot be met for current season germination. Fall seeding, combined with fertilizer and organic matter, assures that moisture is available the following spring during snowmelt. Fall seeding also allows access by machinery.

Most successful seed rates on high altitude areas have been found to be between 25 and 50 pounds per acre, considerably greater than the rates proposed in table IV-4. In addition, a number of the proposed revegetation species are not adapted to higher elevations and success is questionable. Gathering seed at the site from the most active colonizers in undisturbed areas would give better results than the proposed mixture. Seeding could be done in conjunction with the scattered transplanting of local native species when they are dormant. Transplants have a number of advantages, including (1) the developed root systems and root crown portions are not as susceptible to dessication and frost heaving as are young, emerging seedlings; (2) plant survival rate is comparatively high; and (3) transplants are usually capable of seed production after only one growing season, compared to the 3 years required for seeded plants.

5. Range Condition and Stocking Rates

Overall, postmining range condition would most likely improve following reclamation, and recommended stocking rates would increase compared to premining conditions, assuming intensive range management. Since about 75 percent of the proposed disturbance area is currently very stony, present recommended stocking rates are not as high as a comparable area would be without the stones (assuming similar range conditions). Reclamation at the tailing pond area (largest disturbance area) would bury the stones and allow more area for vegetation to grow. However, although forage production would most likely increase, postmining sites would probably have less vegetative diversity than premining sites because of the homogeneity of range sites (which results from soil handling and storage, and uniformity of postmining soil depth).

6. Mitigating Measures

Revegetation of the waste dumps and associated disturbances would be enhanced by the addition of organic matter (such as manure or peat moss) to the soil and waste material. This would increase the water- and nutrient-holding capacity of the material, improving the chances of vegetation success. This measure would be especially critical on any areas to be revegetated at the 1980 adit site, as research has shown moisture to be an important factor limiting vegetation success at higher elevations. In addition, the application of organic matter would hasten the reestablishment of microorganism populations, which are highly beneficial to vegetation.

The implementation of appropriate erosion control measures on the slopes of the Minneapolis adit waste dump and the tailing dam face would minimize erosion rates, allowing a permanent vegetative cover to become established. Such measures should be at least as effective as the application of straw mulch (crimped into the surface) at the rate of 2 tons per acre.

Where premining surveys show that a talus effect is more in keeping with the natural landscape than is vegetation, waste rock should not be revegetated.

The proposed revegetation mixture would be enhanced by the addition of trees, shrubs, forbs, and warm-season grasses where appropriate. This would improve wildlife habitat, which is the company's reclamation goal.

If initial reclamation as proposed by the company is unsuccessful, additional measures, such as those discussed above, would be required.

E. AQUATIC ECOLOGY

1. Summary of Impacts

The aquatic system would not be significantly affected by the proposed project. Game fish populations could be reduced from possible overfishing associated with increases in recreational use of the Stillwater River and tributaries.

2. Impacts on Surface Waters

Typical aquatic life of western mountain streams is highly sensitive to water quality and habitat conditions. Aquatic communities, including fisheries of the Stillwater River mainstem and West Fork tributary, are characteristic of surface waters with good water quality and diverse, stable habitat conditions.

There are three potential sources of pollutants associated with the project; none, either by themselves or together, would significantly degrade water quality or affect aquatic life.

(1) Adit and waste rock dump--Discharges with high sediment loads originating from the adit could reach the Stillwater River; however, the existing series of adequately sized percolation ponds make this unlikely. The percolation ponds can handle 2,000 gallons per minute of flow from the adit, which is about 10 times the maximum adit flows recorded so far during exploration.

Anaconda has an approved MPDES permit, for the purpose of discharging directly to the river. The company, however, has no plans for direct discharge. Should the need arise, adit waters would first have to pass through one or two settling ponds and meet the effluent limitations for suspended sediment and trace elements specified in Anaconda's MPDES permit. In addition, Anaconda would have to perform bioassays on the discharge water to determine, before discharge into the river, if any toxic properties were present.

Anaconda has initiated a study on the toxicity of the adit water. Several treatments with adit water have indicated that the waters are not toxic to rainbow trout. However, this could change with mine

development. Anaconda would be required by the Water Quality Bureau to implement an acceptable biological testing program as a condition of its MPDES permit.

Because of the high porosity of the waste rock dump, little surface flow from precipitation or snowmelt that flowed over the dump would reach the Stillwater River. (See Hydrology.) Therefore, water quality and aquatic life in the Stillwater River would not be affected.

(2) Transportation corridor--Another potential source of sediment could be the transportation corridor between the mine and mill site. It is estimated that 240 tons per year of airborne particulate would be blown from haul trucks. (See Air Quality.) Even without dust control methods, the addition of sediments to the Stillwater River would probably be negligible. (See Hydrology.)

(3) Mill/tailing site--The distance of the mill/tailing site from the river, and the remoteness of the possibility of tailing dam failure, indicate that the likelihood of contamination of the Stillwater River is negligible. (See Hydrology.)

In summary, direct impacts on the Stillwater River from development of the project would be minor. It is not expected that any material would be added to the river that would raise the sediment load, lower the pH of the water, or introduce concentrations of toxic materials, including heavy metals. Aquatic organisms, algae, and macroinvertebrates would therefore not be adversely affected.

3. Other Impacts

Habitat destruction could result because of streambank abuses from activities such as road widening and bridge construction; however, both activities would have to conform to existing laws and regulations, and any impacts would be minor and temporary.

The major effect on the aquatic system would probably result from increased fishing. The increase in the number of people within the Stillwater River Valley can be expected to increase recreational fishing. As a result, the removal of breeding fish could reduce gamefish populations. The amount that fishing pressure would increase is unknown and would depend on the recreational pursuits of future residents. The Department of Fish, Wildlife, and Parks will sample the fishery to establish population characteristics that will help with future fishery management.

4. Mitigating Measures

Mitigating measures to relieve increased fishing pressure would depend on future findings of the Department of Fish, Wildlife, and Parks on fish populations and total fish catch along the Stillwater River.

Although contamination of the Stillwater River by the project is not expected, continued monitoring of ground and surface water should be carried out to reveal changes in quality before major impacts can occur. Monitoring should keep track of chemical and physical variable that would adversely affect stream biota.

F. WILDLIFE

1. Summary of Impacts

Increased disturbances as a result of mining within the Stillwater Valley would affect several wildlife species. The bighorn sheep population has responded to current levels of activity by using suboptimal habitats on the primary winter range; further displacement may lead to herd reduction. Stewart (Montana Department of Fish, Wildlife, and Parks, personal commun., May 18, 1982) believes there exists a small potential for herd reduction. Mule and white-tailed deer populations have not been affected yet, but may be as a result of road kills through increased truck and vehicle traffic, and partially through loss of winter range from placement of the mill/tailing complex in the Hertzler Valley. Elk have been displaced from traditional winter ranges because of increased recreation use and mineral exploration throughout the area. Mineral exploration is expected to decrease; the shift of elk from former ranges may not be detrimental.

2. Description of Impacts

Primary impacts are those resulting directly from mine-related activity. In the Anaconda Stillwater Project primary impacts would arise from construction and operation of the mine, haul roads, and the mill/tailing complex. Secondary impacts are changes arising indirectly from mine development, such as increased hunting pressure and increased use of the Beartooth Wilderness. These two categories of impacts would combine to affect wildlife populations in a number of ways.

a. Habitat loss

The most obvious primary impact of the project would be loss of 156 acres of habitat from construction of such facilities as the tailing impoundment. Habitat loss would continue through the life of the project. The extent and duration of the loss would be determined by reclamation success.

Direct removal of habitat would not result in significant impacts to most wildlife species, primarily because of the small amount of land that would be disturbed. While the permit area totals 780 acres, only 165 would be involved in the mining operation (table III-1). Of these 165 acres, 9 are already disturbed.

The major community type that would be disturbed is the stony grassland type, which supports a low diversity of songbirds and small mammals. Only two species of small mammals were captured in this type (deer mouse and yellow-pine chipmunk), while songbirds made up most of

the birds common to this habitat (vesper sparrow, western meadowlark, and mourning dove).

The expansion of the waste rock dump would remove from wildlife use an area on which reclamation began in 1979. After 1979 bighorn sheep commonly used this area for grazing. The loss of this area would not damage the population. The bighorns can return to the pre-1979 winter range with no change in population condition.

b. Impacts from displacement

A second, though more subtle, primary impact from the project would be habitat loss from displacment. Often animals leave suitable habitat because of nearby disturbances, such as increased human presence or noise. This kind of impact may be the most severe on the bighorn sheep population, for the core winter range for the herd is in the vicinity of the Beartooth Ranch and Anaconda Mineral Company's mine headquarters. Already in 1979-80, several ewes that have wintered on the open slopes adjacent to the ranch increased their home range size significantly, corresponding to the period when mining activity increased within the valley. Apparently the increase in activity has forced the ewes to seek security cover more often than before, increasing the animals' use of suboptimal habitat.

Further evidence of this problem is the sheep's shift in habitat use. In 1974-75, 50 percent of all sheep sightings were in Idaho fescue/ bluebunch wheatgrass and 3-leaf sumac/bluebunch wheatgrass types and 27 percent in security habitat. By 1980-81, in contrast, 61 percent of the sightings were in security areas, while 27 percent were in the open types.

The indication is that bighorns do not use primary forage areas to the full extent during the winter, when good forage is most important. The increased movements result in higher energy requirements and may result in increased death rates. Once full project operation begins, disturbances of this nature would increase.

The long-term impact on the sheep could be severe; activity could result in herd reduction and possibly in herd elimination. Stoneberg (1977) found that earlier mining may have contributed to a gradual decline in population. Bighorn sheep tend to be traditional in their use of winter and summer ranges, and this discourages immigration. Since the herd is essentially isolated, natural dispersal into the area and subsequent reestablishment of herd would take many years.

The tag and radio collar program conducted by the Montana Department of Fish, Wildlife, and Parks determined that major changes in elk distributions have occurred since 1976. The shift has been to the north and west. (See chapter III, Wildlife.) The probable cause cited

was increased construction activity within the Cathedral Mountain subdivision and increased minerals exploration (MDFWP, 1982). The elk population is stable at the present time. Continued monitoring will define changes in the use of known winter ranges.

While the actual shift by elk northward for winter range has not directly affected the population, it has had the undesirable effect of bringing the elk into conflict with private landowners. Competition with agriculture may result in demands for a larger elk kill during hunting season.

Loss of habitat through displacement may also influence use of an important winter mule deer concentration area. The mill/tailing complex lies along the extreme western edge of the Hertzler flats concentration area, at the mouth of Robinson Draw. As many as 100 deer at one time were observed using the hay meadows within the permit boundary. Information on the Hertzler flat deer herd is not as complete as in other areas. Ongoing studies should further define use in the area. Displacement of mule deer, if any, would probably be temporary. Mule deer tend to become accustomed to activity and return if not harassed (hunted on permit area).

c. Secondary impacts

A third kind of affect from the project would be secondary impacts. One of these impacts could be an increase in the number of road kills. Road kills in 1981 totaled 12 deer. This number could increase with the increase in both truck and car traffic caused by project development. Haul trucks are expected to run 24 hours a day at 30 minute intervals. In addition, road use by employees during shift changes would cause increased traffic. This increase would not be restricted to the study area; it would extend along major roads to the communities where most of the employees would live (probably along FAS 419 to Fishtail and and FAS 420 to Absarokee). Problem areas are likely to be those where the road passes through dense growth. Riparian zones and conifer areas where cover is close to the road, such as where the haul road crosses the West Fork of the Stillwater River, would have particularly high road kill rates. Road segments with topographic features that provide cover for travel lanes would also have greater potential for road kills.

Although mule and white-tailed deer would be the primary species killed by vehicles, raptors, while eating carrion, may also be struck by vehicles. If high deer kills occur, bald eagle use of deer carcasses can be expected. White-tailed deer movements are now being monitored and data should assist in reducing collisions. The data may be available for the final EIS and if so will be included.

Increased hunting, both legal and illegal, would be another secondary impact of the project. Tighter controls may have to be implemented. If pressure becomes too intense, a quota system may have to be used for bull elk. Controls on mule deer hunting may also be necessary. Mule deer captured in the study area for marking were extremely young.

If the capture was a true indication--that is, the proportion captured equaled the proportion in the population--the herd has few adult males over two years old. More intense hunting of males would further shift the age structure to younger animals.

The mill/tailing area is located some distance from existing power source. Therefore, it would be necessary during project development to construct a powerline into the facility. The size and route have not been identified, although the line would have to cross the Stillwater and/or the West Fork of the Stillwater River. Powerlines have been identified as a significiant cause of raptor death from collisions and electrocutions (Steenhof, 1978). Until power lines for the project are designed, impacts on raptors cannot be predicted.

3. Mitigating Measures

The Montana Department of Fish, Wildlife and Parks should continue monitoring the bighorn sheep and mule and white-tailed deer populations. This would reveal the actual extent of impacts and allow better and quicker management of herds.

To compensate for loss of winter range (both through habitat disturbance and displacement) of bighorn sheep and mule deer, Anaconda Minerals Company should consider wildlife winter habitat requirements in their revegetation plan. Reclamation efforts on the waste rock dump should be directed toward establishing winter range for bighorns. In addition, Anaconda could pursue wildlife conservation easements on their Beartooth Ranch property and could provide winter forage plantings for mule deer on the mill/tailing site to compensate for habitat loss there. The Forest Service would require that Anaconda maintain a locked gate on the access road to the 1980-level adit to prevent unnecessary traffic and disturbance of bighorn sheep on fall and winter range.

Since vehicle-animal collisions are expected to be a serious problem, particularly for mule and white-tailed deer, road alignment during new construction should avoid trouble spots and critical winter ranges. In addition, fencing or identifying problem road stretches (deer crossing signs), and reducing and enforcing lower speed limits in these areas, would help avoid road kills. A bus system from Absarokee to the mine complex for employees would also reduce the number of road kills.

To eliminate electrocutions of raptors Anaconda should either bury their power lines or construct them as described by Olendorft et al. (1978; Suggested Practices for Raptor Protection on Powerlines--The State of the Art in 1981).

G. THREATENED AND ENDANGERED SPECIES

1. Summary of Impacts

No threatened or endangered plants would be affected by the project.

The U.S. Fish and Wildlife Service has identified historical nesting habitat for peregrine falcons on a cliff complex near the proposed haul route. The proposed activities may prompt nest abandonment or discourage this endangered species from selecting nesting sites on the cliff complex (U.S. Forest Service Biological Assessment, February 23, 1982).

2. Plants

As discussed in chapter III, mountain ladyslipper, found in the 24,547-acre study area, is included on the list of proposed threatened or endangered plant species published by the U.S. Fish and Wildlife Service. However, mountain ladyslipper was not found in the proposed permit area (which makes up less than 1 percent of the vegetation study area); therefore, no impacts are anticipated.

3. Wildlife

The Forest Service has determined that the location of the haul road "may affect" the suitability of the historical peregrine falcon nesting cliff discussed in chapter III (U.S. Forest Service Biological Assessment February 23, 1982). Traffic expected on the road might disturb nest site selection or prompt nest abandonment by this endangered species. Construction during March through May could also cause nest site abandonment.

In addition to the potential impacts on peregrines, bald eagles could be shot or hit by traffic while eating carrion on the roads in and near the permit area.

Powerlines have been identified as a significant cause of eagle and falcon death from collisons and elecrocutions (Steenhof, 1978). Until powerlines for the project are designed, impacts on eagles cannot be predicted.

4. Mitigating Measures

To mititage the effects of road use and mill construction on the nesting of peregrine falcons, a relocation of the haul road is being explored. To further mitigate the impacts on peregrine nesting, heavy equipment use within one-half mile of the historical peregrine cliff should be scheduled outside the nest site selection period of March 1 to April 30. Activities that would generate extremely loud noises (greater than 100 decibels), such as blasting, should also be scheduled outside

the nest selection period. If the nesting sites should become occupied, heavy equipment activity and activities generating loud noises should be deferred until after fledging in June and July.

Commuter bus service, described as a mitigation measure in other sections, would also help mitigate the disturbance of peregrines.

To eliminate the electrocution hazards to eagles and falcons that can be caused by powerlines, Anaconda should either bury the lines or construct them as described by Olendorf et al. (1978). To reduce bald eagle road kills, animal carcasses could be removed from FAS 419 and 420.

H. CLIMATE

The small amount of particulate emitted from ground-level sources during mining and milling would not affect the climate of the area.

I. AIR QUALITY

1. Summary of Impacts

Particulate matter would be the only pollutant emitted in significant quantities by activities associated with the proposed project. Even so, particulate emissions would be minor. Modeling results indicate that TSP (total suspended particulate) concentrations would increase by a maximum of 7 ug/m^3 (micrograms per cubic meter) and the mine and 5 ug/m^3 at the mill (annual averages). Ore dust blown from haul trucks may be a nuisance to residents living along the county roads (FAS 419-420) between the mine to the mill. Wind erosion of disturbed areas during construction activities would also be a potential, but temporary, source of particulate.

2. Description

Particulate emissions from the mining and milling operations would be minor. Total emissions would be 23.2 tons per year with 75 percent of this coming from the mine (table IV-6). The major source at the mine would be the ventilation exhaust, emitting 5.6 tons per year. The crusher and conveyors at the mine would be enclosed, preventing emissions. Little particulate would be emitted from the mill. Scrubbers would remove almost all particulate. The tailing would be continually wet, precluding the emission of wind-blown particulate from the impoundment.

Camp Dresser and McKee (CDM, 1981) used the EPA Valley Model to predict maximum annual average TSP concentrations at the mine and mill. Based on a daily ore production of 1,440 tons, the maximum annual average TSP concentrations would be 21 ug/m^3 at the mine and 26 ug/m^3 at the mill site. This would still be well below the Montana standard of 75 ug/m^3 and would represent an increase of only 5 to 7 ug/m^3 at the two

TABLE IV-6--Anaconda Stillwater Project
Particulate Emissions Inventory
[Source: Anaconda Copper Co., 1981; on-file report, DSL, 1981]

Source	Particicluate Emissions Tons/Year
Mine Site	
Train Dump	1.5
Grizzly	0.9
Apron Feeder	4.4
Jaw Crusher	0.4
24-inch Belt Conveyor	0.4
Coarse Ore Loading to Haul Trucks	0.0
Mine Ventilation Exhaust	5.6
Emergency Ore Stock Pile	0.2
Waste Rock Dump	2.7
Waste Rock Dumping from Train	0.2
Waste Rock Dozer	0.8
Topsoil Storage Pile	0.2
Mill Site	
Truck Dump	1.7
Apron Feeder	0.5
24-inch Belt Conveyor	1.1
Vibrating Screen	0.5
Short Head Crusher	0.2
24-inch Belt Conveyor	0.6
24-inch Belt Conveyor	0.5
24-inch Belt Feeder	0.5
Holoflite Dryer	0.3
Product Layout	0.0
Mine-Mill Site Road	
Haul Trucks	16.1
Vehicle Traffic	0.4
Ore blown from trucks	222.0

TOTAL PARTICULATE EMISSIONS		
	Minesite	17.3
	Millsite	5.9
	Haul Road	238.5
		261.7

sites. The air quality of the Beartooth-Absaroka Wilderness would not be affected.

Ore dust blown from the haul trucks was not considered in the model and could be a major source of additional particulate. Emission factors for this type of source have yet to be developed. The emission rates were estimated using the universal soil loss equation (on-file report, DSL, 1981), as is done to predict wind erosion. Ore dust blown from the haul trucks could total over 238 tons per year, which in turn could increase TSP concentrations adjacent to FAS 419 and 420 from the mine to the mill. The amount of increase is not known. Particulate entrained from the road surface by the haul trucks would add 16 tons per year to the amount blown from the trucks. The combined particulate emissions would total about 238 tons per year. For comparison, a similar amount of particulate would be emitted annually by a single vehicle making 15 round trips per day, 365 days per year at 50 miles per hour on FAS 420 from Nye Junction to Absarokee.

The residents living adjacent to FAS 419 and 420 between the mill and the mine may be exposed to increased TSP concentrations. These concentrations plus the higher noise levels (see Aesthetics) may cause the residents annoyance and discomfort.

Ore concentrate would be stored in sealed containers and trucked to Columbus for shipment by rail to various markets. No concentrate particulate would be emitted during hauling to Columbus.

The presence of potential mutagens and carcinogens in the ore and concentrate was of major concern to the Montana Air Quality Bureau (AQB). However, the evaluation of emissions from mining and milling activities indicates that the particulate concentrations in populated areas would be low. The AQB therefore determined that adverse health impacts would probably not occur (H. Robbins, Chief, AQB, written commun., March 1982). Other research shows that the miners' health probably would not be adversely affected either (National Research Council, 1977).

During the construction of the mill and mine complexes, disturbed areas may be eroded during periods of high winds. This would be temporary only and is not anticipated to affect average TSP concentrations.

3. Mitigating Measures

When needed, the Forest Service would require that Anaconda apply dust suppressant to the mine parking area, service roads, mine dump, and FS 846. The Forest Service would also require when needed that ore trucks be covered or their loads be treated with a dust suppressant.

The AQB could require that Anaconda implement similar dust control measures. In addition, if particulate emissions from any mining and

milling activity were determined to be a nuisance, the AQB could require Anaconda to reduce or eliminate those emissions.

J. EMPLOYMENT AND INCOME

1. Summary of Impacts

The operation of the proposed mine would create a total of about 263 new jobs in Stillwater County. The new jobs would represent two thirds of the total employment growth projected for the county during the 1980s. An additional 50 short-term jobs would result between 1989 and 1992 when a second internal support shaft would be developed.

The industrial composition of the county's economic base would be affected slightly. Growth in mining employment would make up for projected losses in agriculture, but agriculture would continue as the county's largest basic industry employer.

2. Employment

The 263 new jobs created by the project would represent an increase of 12.5 percent over the 1979 figure for total number of jobs in the county and 9 percent over the projected 1989 and 1999 figures.

During the 30-month construction/development phase of the mine, direct employment would average 172. Actual employment would fluctuate from month to month on a seasonal basis between a low of 59 jobs in month six and a high of 243 jobs in month 14.

The permanent operating work force is expected to number 200 throughout the 20-year life of the mine. Development of an internal support shaft is currently projected for 1990, 1991, and 1992; this would cause a short-term increase of as many as 35 jobs at the mine for this period.

Local government and area business employment would increase by about 83 jobs in response to the new employment at the mine (Briscoe, Maphis, Murray, and Lamont [BMML], 1981, pp. 3-8 and 4-10). Trade and services employment would increase by 30 jobs, local government employment by 27 jobs, and the remainder would be divided among other industries.

Each of the three phases of the mine would exhibit a different employment combination of in-migrants, commuters, and local residents. The development phase construction work force would largely consist of employees of Billings area construction firms, (BMML, 1981, p. 5-4). Thirty-eight percent of this work force would prefer to commute daily; the rest would probably commute weekly.

Mine development is a highly specialized skill. Thus, 80 percent of the development phase mining work force is expected to be provided by a contracted firm from outside the state. The remaining 20 percent

would be hired locally if training is provided. Most of the mine development work force would reside in Stillwater County.

The permanent operational work force would be made up of in-migrants (60 percent), local residents (30 percent), and 10 percent would commute each day from outside the county (BMML, 1981, p. 5-5). Based on the number of local people employed at the mine in 1980-81, half of the local resident work force (30 persons) already works for Anaconda Minerals Company.

The proportion of the mine/mill work force that would be local residents is potentially much higher than the currently projected 30 percent. The mine would experience a monthly turnover rate of at least 3 to 5 percent (Jim Harrower, Anaconda Minerals Company, oral commun., February 1, 1982). This amounts to a replacement of the entire work force every 2 to 3 years. There is a large pool of potential applicants for work at the mine and mill. Twenty-one percent of the employed and 63 percent of the unemployed persons in the Stillwater County Resident Survey (Entercom, 1981, p. 524) indicated that they would be somewhat or very likely to apply for a job at either the mine or mill operation. At the 1981 employment level this indicates a pool of applicants that would number about 600, three times the number of jobs. If local residents were more likely to stay on the job than in-migrants, over time the proportion of local residents working at the mine/mill would increase.

After the mine/mill ceases operation the employment base would shrink to what it would have been if the mine had never existed. Persons laid off from the operation would either leave the area seeking employment or compete for the other jobs in the vicinity. Because the mine-related employment would not be a large portion of the total, readjustment after closure would not be greatly disruptive.

3. Income

The annual wages of the employees of the mine and mill operation would range between $13,000 for a typist and $50,000 for the mine manager. Most of the employees would earn between $24,000 and $35,000 a year (BMML, 1981, p. 4-6). This is considerably greater than the average amount earned by the currently employed persons in Stillwater County, three fourths of whom earn less than $24,000 per year (Entercom, 1981, p. 937).

Per capita income in the county would be about 3 percent greater if the mine and mill remains in operation than would otherwise be the case (BMML, 1981, p. 4-15). Per capita income would be greater because the jobs at the mine and mill would increase the proportion of jobs in the upper wage brackets and not because wages in other industries would be increased.

The wages paid at the mine and mill operation could be a stabilizing influence on total personal income in Stillwater County. Ordinarily the new payroll would dampen the effect of year-to-year

variations in agricultural income. However, should the payroll be interrupted during a poor agricultural year (i.e. because of a lengthy labor dispute or a decision by Anaconda to close the mine for economic reasons) then the instability in total personal income would be intensified.

K. SOCIOLOGY

1. Summary of Impacts

The greatest change would be in the population structure of Absarokee and Nye. The occupational structure of Absarokee would shift to a large proportion of jobs in mining. Some current residents of the Absarokee community would have less influence over community matters. By 1991 Stillwater County's population would increase 12 percent, and Absarokee's 54 percent, over the figure that would be reached without the project.

2. Demography

The additional population that development of the Anaconda Stillwater Project would add to Stillwater County would peak at 667 persons, or 12 percent of total population, by 1991. (See table IV-7 and fig. IV-3) This increase would put the population 15 percent above the 1980 level and would be about three fourths the size of the increase the county experienced between 1970 and 1980.

Growth would probably occur primarily in Absarokee, unless Anaconda encourages settlement in another area. Absarokee's population would increase 54 percent, or 422 by 1991. Columbus's increase would peak at 115 by 1991, an increase of 8 percent over the figure that would be reached without the project.

Eighty percent of the permanent project operational work force would probably be married. Average family size would be about 4, resulting in a direct mine-related migration into the county of 416. Of the 416, 60 percent would reside in Absarokee, 15 percent in Columbus, and the remaining 25 percent would locate in Nye, Fishtail and other unincorporated parts of the county. The indirect population increase of the project would amount to another 251 persons (BMML, 1981).

3. Occupational Structure

The occupational structure of the county would change: 18 percent rather than the current 12 percent of those employed would be blue collar workers (operators, laborers and fabricators). In the Absarokee census division the proportion employed as blue collar workers would increase from 4 to 22 percent (Entercom, 1981, p. 895).

TABLE IV-7--Numbers of People Expected to be Added to the Population of Stillwater County as a Result of the Anaconda Stillwater Project

Year	Stillwater County Number	Percent
1980	0	-
1981	1	-
1982	60	1
1983	335	6
1984	335	6
1985	552	10
1986	551	10
1987	551	10
1988	551	10
1989	551	10
1990	537	11
1991	667	12
1992	665	12
1993	584	10
1994	582	10
1995	547	10
1996	542	10
1997	541	9
1998	537	9
1999	535	9

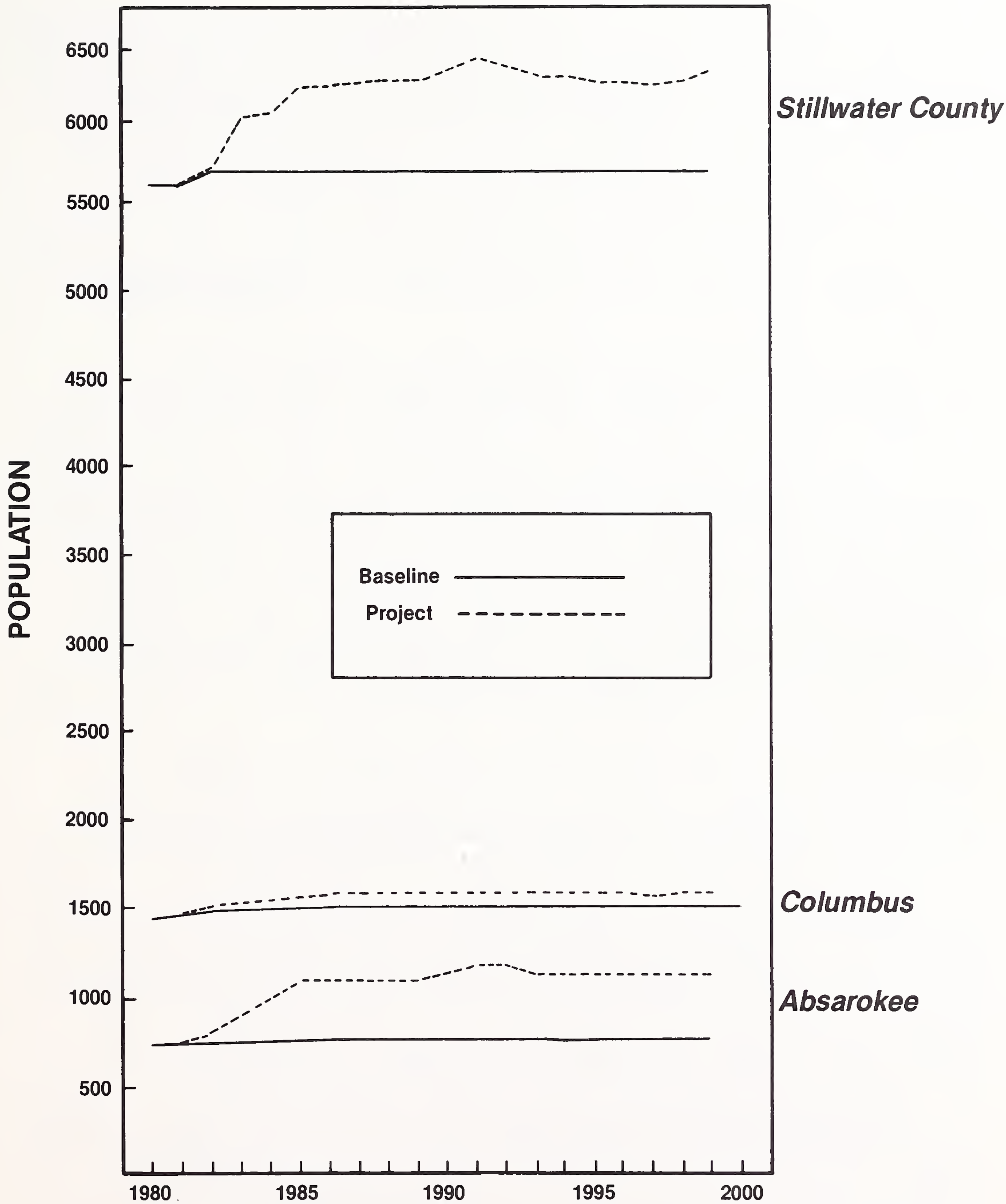


FIGURE IV-3--The Projected Population of Stillwater County With and Without (baseline) the Proposed Project

4. Values

How the values of newcomers would differ from current residents is not known. How much commitment they would have to their new community is not known. The employee turnover rate is expected to be approximately 3 to 5 percent, or 6 to 10 persons, per month (Jim Harrower, Anaconda Minerals Company, oral commun., February 1, 1982).

5. Project Concerns

Chapter III details the concerns expressed by county residents over the project. A discussion of the likelihood of residents concerns occurring follows.

The mine and mill operaton would provide 200 permanent jobs, 60 of which would be filled by people already living in the county. Half of this local work force already works for Anaconda. (See Employment and Income.)

It is not known if the cost of living in the county or local areas would rise more during mine construction and operation than it would in other areas of the region. Housing prices could rise initially until the housing supply caught up with new demand. Seventy-nine percent of the residents surveyed stated that they thought the cost of housing would be worse if the mine were developed (Entercom, 1981). It is not known how much housing prices would rise. Land prices might rise with the development of the project. If they did, ranchers attempting to expand their operations would have more difficulty.

Ranchers moving cattle along the roads between the minesite and mill site (about 7 miles) would be inconvenienced by the passage of 2 or 3 ore trucks per hour plus the additional traffic generated by the increased population. A further result of increased traffic would be more deaths from vehicle accidents. (See Transportation.) The traffic could also be viewed by some residents as a reduction in privacy.

Wage rates for ranch workers should not rise as a result of the project. For comparison, between 1970 and 1979 Rosebud County experienced a large increase in mine employment due to coal development. Despite this large increase in mine employment, the average annual income of local farm workers increased at a slower rate than did the income of farm workers statewide (U.S. Department of Commerce 1980a, 1980b, 1981a, 1981b). The level of development in Rosebud County was much greater than what would result from the Anaconda Project.

The project would not cause rapid social change in the county. Nor would the increased population much alter the existing political structure of the county. Newcomers may have different expectations of local government, such as types of services they believe should be provided, but their proportion of the county's population would be small, and they would therefore not constitute a threat to existing county government practices. In Absarokee, in contrast to the county as

a whole, newcomers would comprise 35 percent of the population by 1991; they could thus easily influence decisions at the local level. The population increse may give current residents the feeling that they have less control over matters affecting their community.

6. Mitigating Measures

If Anaconda provided bus service for its employees from Absarokee to the job site, traffic increases could be less, resulting in fewer vehicle accidents and less inconvenience to ranchers moving cattle.

L. COMMUNITY SERVICES

1. Summary of Impacts

The proposed project would result in additional demand for staffing, space, equipment and or operating revenue by the Absarokee school system; the City of Columbus; the Stillwater County law enforcement system; the Absarokee Water Users Association; Sewer district number five and seven; and possibly the Stillwater County Welfare Department. Additional housing would also be needed as a result of the project.

2. Description

The demand on services presented below represents the amount needed in addition to that given in chapter III, that is, the demand added by the population increase arising from development of the proposed project.

a. Schools

The Absarokee school system may require six or seven additional classrooms and seven to nine additional staff if new children are nearly equally distributed among the different grades. The students from the Nye/Fishtail area that currently attend school in Absarokee--about 35 students--would not be able to continue to do so if the Absarokee schools reached capacity with students from the Absarokee School District. The Nye school would need to expand to accommodate these additional students (Jim Richard, personal commun., April 1982).

b. Solid Waste

Stillwater County would require a 40-yard container and a new site by 1985. Columbus would need another person on staff and possibly another truck by 1985. Operating costs would increase in both the county and Columbus (Jim Richard, written commun., February 26, 1982).

c. Law Enforcement

Stillwater County would need an additional police officer to maintain the current officer/population ratio. The additional officer

would be needed mostly in the southern portion of the county because the Absarokee/South County District is already generating a need for an additional deputy and because the southern portion of the county would receive most of the population influx from the proposed project. One additional staff person would also be required and probably one additional vehicle. The population influx would add to the existing need for a jail facility.

d. Water Supply

The Absarokee Water Users Association would need a new shallow well, a 100,000 gallon storage tank, and additional collection lines by 1985. By 1991 the Association would need even more lines. Columbus would also require additional lines by 1985, and its operating costs would rise (Jim Richard, written commun., February 26, 1982).

e. Sewer System

Sewer districts numbers five and seven in Absarokee would require an oxidation ditch and new collection lines by 1985. Columbus would require a one-acre addition to the lagoon and additional sewer lines by 1985. Operating costs would increase in Absarokee and Columbus (Jim Richard, written commun., February 26, 1982).

f. Fire Protection

Operating costs would rise approximately $6,600 per year in Columbus (Jim Richards, written commun., February 26, 1982). The areas outside Columbus, Absarokee, Nye, and Park City would remain unprotected for structural fires.

g. City Shop

Columbus would need a new shop approximately 40 by 60 feet. Some Columbus streets would require storm drainage and paving by 1985 and one more person on staff by 1991. Operating costs for maintaining the streets would increase (Jim Richards, written commun., February 26, 1982). (See Transportation for information on roads.)

h. Hospital and medical personnel

The hospital would be able to handle the additional inpatient services required by the larger population, but the increase in outpatient services would require an additional doctor. The community has no trouble recruiting doctors to the area (John Bartos, Stillwater Community Hospital, oral commun., March 4, 1982.)

Although the mine would not increase the number of elderly people in the county, some younger newcomers may require intermediate or skilled care. The Stillwater Convalescent Center currently operates at capacity.

i. Human services

The Stillwater County Mental Health Center would probably not have to increase staff to handle the additional demand for services. Newcomers may require more short-term crisis treatment (Scott Schreiber, Stillwater County Mental Health Center, oral commun. March 1982).

The Stillwater County Welfare Department may require a full rather than half-time social worker. Another eligibility technician may also be needed (Diane Altimus, Stillwater County Welfare Department, oral commun., March 1982).

j. Housing

The proposed mining project's operation phase would add about 134 households to Stillwater County. About 80 additional housing units would be needed if all vacant housing units that are now for rent in the county were occupied by these newcomers. More than 80 units would probably be needed because the vacant units for rent may not be located where newcomers choose to live and newcomers may prefer not to rent. Assuming the vacancy rate remains constant, 134 housing units would be needed in the county. About 88 of these units would be needed in Absarokee; the remainder would be distributed according to the settlement pattern of newcomers. (See Demography.) Anaconda has purchased 340 acres adjacent to the Absarokee community that could be developed for housing. This space could easily accommodate the additional housing needed in the Absarokee area. Columbus has enough space platted for development within the city limits to accomodate the additional housing needed there.

3. Mitigating Measures

Anaconda could mitigate the housing impact by constructing housing units to sell or rent to employees, subsidizing housing contruction, providing financing to employees, or developing housing lots on the company's property near Absarokee.

Anaconda could initiate the formation of a rural special improvement district to provide fire protection for the area where their employees would likely settle.

All of the impacts to community and social services could be reduced by hiring people already living in the area to the extent possible. Providing on-the-job training would increase the number of qualified lcoals.

M. FISCAL CONDITIONS

1. Summary of Impacts

The proposed project would directly increase the tax base of the Nye elementary school district, Absarokee high school district, and

Stillwater County by about $6,853,000. Over the life of the mine the State would receive about $11 million in revenue raised through the Metalliferous Mines License Tax and the Resource Indemnity Trust Tax.

2. Tax Base

The proposed mine would produce taxable value directly and indirectly. The direct increase would consist of the gross proceeds value of the mine's production and the value of the property associated with the mine and mill. Indirect increases would result from the value of the homes established by miners. Most of the taxable value would not be available to the taxing jurisdiction until 1986, the year after production begins.

The taxable value of the mine's production would amount to 3 percent of the gross value of minerals produced each year. At full production and at January 1982 prices as reported in the Engineering and Mining Journal (February, 1982), the gross proceeds value would amount to approximately $853,000 per year. (See table IV-8.) The taxable value of the mine and mill would be about $6 million (Steve Dole, Anaconda Minerals Company, oral commun., March 9, 1982).

TABLE IV-8--Annual Production and Value of Minerals

[Source: U.S. Bureau of Mines, 1981; Engineering and Mining Journal, February 1982]

Mineral	Amount (troy ounces)	Value per troy ounce	Total Value
Platinum	30,977	$475.00	$14,714,075
Palladium	108,675	110.00	11,954,250
Rhodium	945	600.00	567,000
Iridium	368	470.00	172,960
Osmium	263	152.00	39,976
Ruthenium	53	45.00	2,385
Gold	2,573	384.00	988,032
TOTAL	143,854		$28,438,678

3. Beneficiaries

Only the county, the elementary school district at Nye, the high school district at Absarokee, and the State would benefit directly from the increased taxable value. Some affected jurisdictions would benefit only indirectly--in particular, the Absarokee elementary district and to a lesser extent the Columbus schools, because of the new homes that would be built in their districts.

4. Metalliferous Mines License Tax

The State of Montana would receive an annual license tax from the proposed mine. The tax paid would amount to $3,452.50 plus 1.438 percent of the gross value of mine's production over $500,000 per year, or about $405,210 per year. Over the life of the mine the tax would amount to about $8,104,200, assuming constant prices and a 20-year mine life. The actual amount would, of course, depend on the price of the various metals.

5. Resource Indemnity Trust Tax

The State levies a tax in the amount of $25 plus 0.5 percent of the amount of the gross value of the production in excess of $5,000 against all mining in the State. The tax is paid into the Trust and Legacy Fund. The fund is intended to provide security against loss or damage to the State's environment from the extraction of nonrenewable material resources. The tax from the proposed mine would amount to about $142,193 per year; at current prices and assuming a 20-year mine life, a total of $2,843,860 would be paid into the trust fund.

6. Mitigating Measures

The recently enacted hard rock impact assistance program established by House Bill 718 would be of some help in the adversely affected areas. The intent of the legislation is "to provide a system to assist local government units in meeting the initial financial impact of large-scale mineral development" (MCA 90.6.301). The legislation requires that the developer of a large-scale hard-rock mine or associated milling facility prepare a fiscal impact plan. This plan would identify and commit the developer to pay all of the increased capital and net operation costs to local government units that would be a result of the mine or associated milling facility. The possible revenue source identified in the legislation include the following: grants to impact area local governments, prepayment of taxes by the developer, special industrial education impact bonds, and direct impact payments by the company for a specific local government activity. At the time of this analysis, no impact plan has been offered by the Anaconda Minerals Company. Thus, it is not known to what extent the HB 718 program would correct the problem of some areas receiving revenue after it is needed. Combining the Nye and Absarokee elementary school districts would partially solve this problem.

N. LAND USE

1. Summary

The direct land use impacts of the proposed mine would be temporary and would not significantly affect land use patterns in the area. A total of 165.8 acres would be disturbed and as many as 34 acres of land would be permanently converted to residential uses. The proposed postmining land uses of wildlife habitat, agriculture, and recreation

would be feasible; the postreclamation range condition would be better than it is now and wildlife habitat reclamation would be moderately successful.

2. Permit Area

The tailing disposal pond would be the largest single disturbance, accounting for nearly 80 percent of the total land disturbed by the project. Almost all of the tailing site is currently of the stoney grassland type and is used for grazing. (See Vegetation.) Assuming that the area would be out of production for 25 years, a total of 1,475 potential AUMs would be lost during the life of the project. This would not significantly affect agricultural production either in the area or in the county as a whole. Because the tailing reclamation area would be less stoney than it is now, its potential overall stocking rate would increase. (See Vegetation.)

Reclamation of the area around the mine would only be moderately successful as wildlife habitat (see Vegetation); however, less than 25 acres would be disturbed, so this would not be significant.

3. Indirect Consequences

Assuming that each of the 134 new households to the area would use an average of 0.25 acres (FES 80-1) for homes, as many as 34 acres of agricultural land would be permanently removed from production.

The increased traffic on county road FAS 419 might hinder livestock grazing management on adjacent lands but the use of the land would not be precluded.

O. TRANSPORTATION

1. Summary of Impacts

Travel related to the proposed mine would significantly increase traffic volumes on FAS 419 and FAP 78 because of increases in work, household, and truck trips. FAS 419 would be most affected by work and ore truck traffic, FAP 78 by household trips. Increased traffic would result in increased vehicle accidents and road maintenance costs. Ranchers, recreation travelers, and wildlife could be adversely affected by the increased traffic. (See Recreation and Wildlife.)

2. FAS 419

Assuming that miners reside as projected in Employment and Income at the full production rate, average daily traffic (ADT) on FAS 419 between Absarokee and Nye (fig. IV-4) would increase by 223 because of work trips to the mine and mill (Eric Hinzel, CDM, written commun., February 29, 1982). Based on 4 trips per household per day (James Hahn, Montana Department of Highways, written commun., September 14, 1981) ADT increases due to increased population would amount to 51. Between Nye

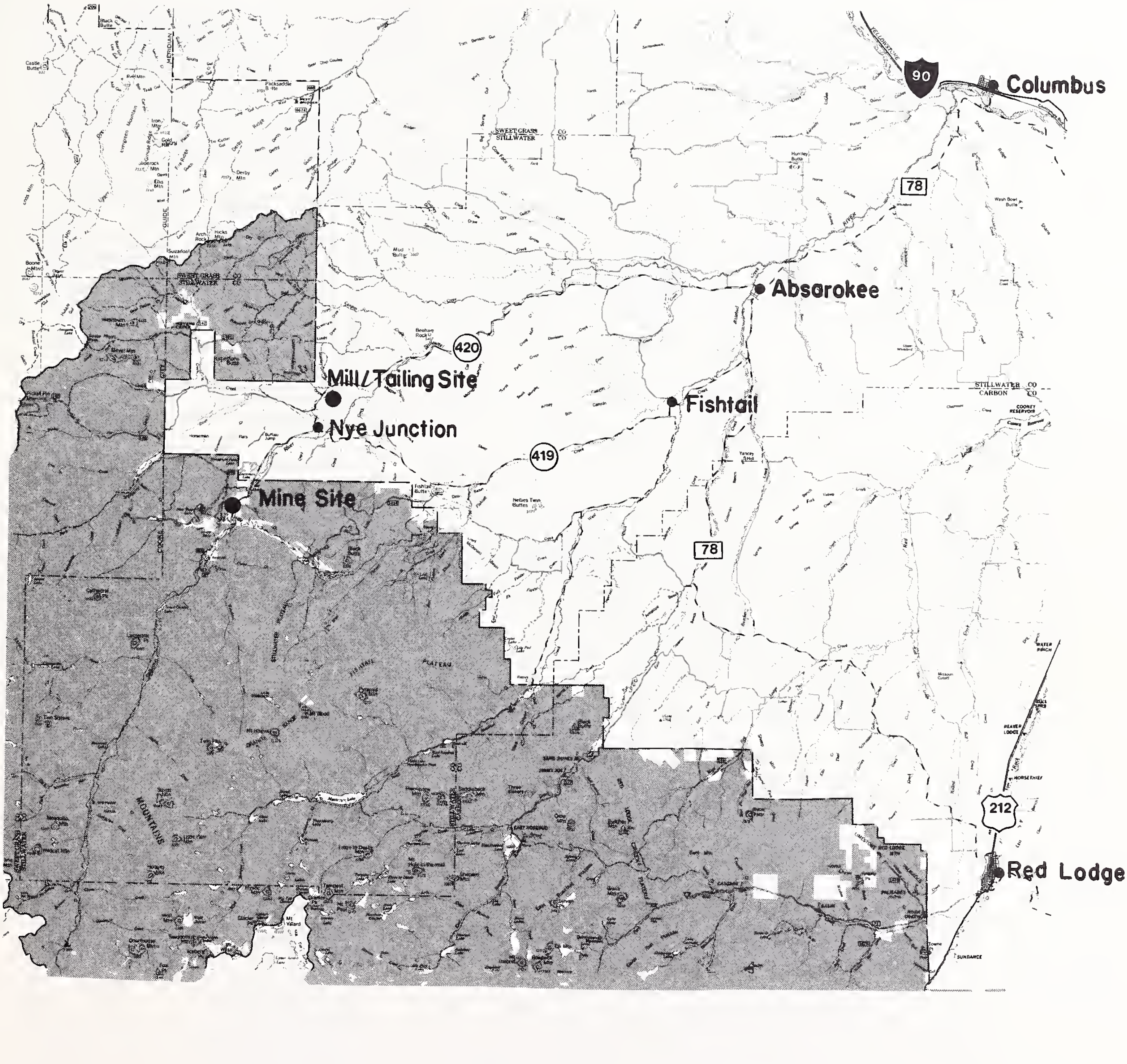


FIGURE IV-4--Road System in Stillwater County

TABLE IV-9--Current and Projected Traffic

	Current Conditions (1980)					Future Conditions (Total for 20 years of Operation)				
Road Segment	ADT[1]	Accident Rate[2]	Accidents 1977-80	Injuries Rate[3]	Fatality Rate[4]	Net Additional ADT	Net Addition Vehicle Miles[5] (millions)	Accidents	Injuries	Fatalities
FAS 419[6] (Absarokee to Nye Jct.)	437	8.49	86	.48	.015	274	40.8	346	166	5
FAS 419[6] (Nye Jct. to Minesite)	260	1.80	4	.48	.015	324	11.8	21	10	0
FAP 78[6] (Columbus to Absarokee)	1,014	3.35	99	.48	.015	387	53.11	178	85	3
TOTAL			189					545	261	8

1 ADT = Average Daily Traffic [Sources: HKM Associates, 1981, p. 17; Montana Department of Highways, 1980, p. 93]
2 Accident rate = number of accidents per million vehicle miles [Sources: HKM Associates, 1981, p. 18, figure 3; CDM 1981, p. 2.9-12]
3 Injuries/Accidents, statewide rate, 1980-81. Source: Williams, written commun., May 18, 1982.
4 Fatalities/Accidents, statewide rate, 1980-81. Source: Williams, written commun., May 18, 1982.
5 Total net addition of millions of vehicle miles accumulated over 20 years = (Average Net Additional Traffic) X (segment length) X (20 years) X (365 days)
6 Segment lengths: FAS 419 (Absarokee-Nye) 20.4 miles, FAS 419 (Nye-Mine) 5.4 miles, FAP 78 (Columbus-Absarokee) 18.8 miles

Junction and the minesite, the ADT increases would amount to 324, 187 due to work trips, 110 due to ore haulage, and 27 due to household trips.

Based on 1977-80 accident rates (table IV-9), over the 20-year life of the mine there would be an additional 367 accidents on FAS 419. Based on 1980 and 1981 statewide rates, 176 people would be injured and 5 would be killed in accidents (Jack Williams, Chief, Evaulation and Research Bureau, Highway Traffic Safety, Montana Department of Justice, written commun., May 18, 1982.)

Assuming that road maintenance costs are directly related to traffic volumes, costs would nearly double due to the proposed mine. Maintenance costs on the part of FAS 419 that would be constructed by Anaconda would be substantially lower than the costs for the rest of the road. A short segment of the road at the minesite would be relocated by the company. (See chapter I.)

The increased traffic on FAS 419 could hinder the movement of livestock on or across the road.

3. FAP 78

Average traffic volumes on FAP 78 between Columbus and Absarokee would go up by 387 trips per day, 354 due to household trips and 33 due to work trips. Based on the 1977-80 accident rate and the 1980-81 statewide injury and fatality rates, over the 20-year life of the mine there would be 178 additional accidents, injuring 85 and killing 3 people (Jack Williams, written commun., May 18, 1982).

Maintenance costs would increase by about a third due to the proposed mine.

4. U.S. Forest Service Road 846

Forest Service road 846 is used by the public to reach the Wilderness trailhead on the West Fork of the Stillwater River, as well as other national forest system lands. The road also provides access to the mine exploration road that leads to Anaconda's 1980-level adit.

In its present location, the road routes the public through the minesite--a situation unacceptable from the standpoint of public safety and efficient mine operation. Anaconda proposes to relocate the road to the south and west. This could adversely affect visual quality. (See Aesthetics.) It would also create more potential for erosion, but such impacts would be mitigated by proposed rehabilitation measures. (See Soils.) Road maintenance needs would increase above the level needed if the mine were not developed. The added maintenance costs would be borne by the company.

5. Access Road to the 1980-Level Adit

Anaconda reaches the 1980-level adit via FS 846 and a mineral

exploration road that leads to the former town of Mountain View. The access road to the 1980-level adit is discussed in the Forest Service's Environmental Assessment of the 1980-level adit (on file with Custer National Forest). Use of the road is not covered in Anaconda's current application, but rather in the 1981 exploration operating plan. Continued use during full mine operation would have no adverse affect, provided the road is maintained.

5. Mitigating Measures

Reconstruction of the highway between Absarokee and the minesite could reduce the accident rate. Intensive patrolling of the road, particularly the first 10 miles south of Absarokee, would probably be a more effective way to reduce the number of accidents.

Another way to reduce accidents and at the same time save energy would be to reduce the number of project-related trips by the establishment of a commuter bus service from the Absarokee area for employees. The commuter bus service could be provided directly by Anaconda or the company could subsidize an independent transportation system that the employees would be encouraged to use. Although this would alleviate some of the projected problems on FAS 419, it would be of only slight help to FAP 78. Alternative methods of transporting the ore to the mill site, such as conveying system or a parallel haul road would also be of only marginal help, and even what slight benefit a parallel road or conveyor would have would be confined to the short section of FAS 419 that has a much better safety record than the other road segments affected by the project.

Local ranchers could partially mitigate the potential conflict between use of FAS 419 by livestock and haul trucks by not moving livestock along the road during shift changes. Anaconda should inform ranchers in advance of any change in shift hours. The conflict could be further mitigated by instructing haul truck drivers to give the right-of-way to livestock on the road.

The Forest Service would require that Anaconda obtain a permit to relocate FS 846. The design for the road would be provided by Anaconda and be subject to approval by the Forest Service. The permit would call for signing adequate to alert public users of the proper route to follow.

The Forest Service would also require a road maintenance agreement with Anaconda for FS 846 and the access road to the 1980-level adit. The agreement would require that Anaconda bear a share of road maintenance proportionate to the company's use. This agreement would cover the road from FAS 419 to the 1980-level adit.

To avoid spring breakup of the haul road between the mine and mill, Stillwater County would place limits on FAS 419 and 420.

P. RECREATION

1. Summary of Impacts

The project would bring some increased use to both the national forest and private lands adjacent to the Stillwater River. This could increase person-to-person contacts; put additional public pressure on the Forest Service to gain new public access routes to the national forest; increase harvest of fuelwood; cause weekend crowding at campgrounds. Visual changes and noise from the mine would affect the recreational quality of the Moraine Fishing Access Site. In addition, traffic from shift changes at the mill and mine could cause increased traffic on Friday and Sunday afternoons, when recreation travel is heaviest.

2. National Forest and Wilderness Recreation Resources

The local area, including Yellowstone County, supplies about 70 percent of the visitors to the part of Custer National Forest near the Anaconda Stillwater Project. The addition to this area caused by project development of 150 families or about 525 people would not measurably affect regional recreation demands; however, since the addition would occur mainly within 30 miles of the affected national forest lands, some increased pressure on area campgrounds and dispersed areas would result. This increase could be accommodated within the estimated biological carrying capacity of the area.

The carrying capacities of the national forest lands, however, are finite. They are directly related to the intensity of management. The capacities listed in Chapter III (table III-18) are for high intensity management. The Forest Service has found that if the level of management is reduced, the capacity for use without unacceptable biological degradation will be reduced. For example, day-use capacity of the lower Stillwater drainage inside the Wilderness is estimated to be 125 people per day with intensive management. This would be reduced to 75 people per day if wilderness rangers did not patrol the area, enforce local rules, and promote low-impact camping practices. With increased use, national forest administrative costs would probably rise.

With the exception of holiday weekends, campsites are always available during the summer season. Actual use counts made in July and August in the Rosebud and Stillwater areas indicate only 60-80 percent of the existing capacity is being used. Capacity estimates in people-at-one-time (PAOT) made of the roads, roadside areas, and day-use portions of the Wilderness also reveal unused capacity is available. Nevertheless, holiday weekend use reaches capacity now. With the increased use that would be induced by the Anaconda Stillwater Project, person-to-person contacts would increase both in the campgrounds and in the day-use part of the Wilderness Area around Sioux Charlie Lake on the Stillwater River. Some people would have to seek campsites elsewhere.

Increased use would also put added pressure on the Forest Service to acquire new public access routes to national forest lands, and put

pressure on private landowners adjacent to the national forest boundary to allow passage across their land.

Additional demands for fuelwood would also result from the increased number of people. At present demand levels, wood supplies are adequate to meet demand.

3. Off-Forest Recreation Resources

On lands that are not part of the national forest, the visual change created by the tailing site would make the Moraine Fishing Access much less desirable for recreation for some people. Noise pollution may also decrease the site's attractiveness (Ray Burntsen, Regional Park Manager, Department of Fish, Wildlife, and Parks, personal commun., March 2, 1982). Additional highway traffic, too, would reduce the enjoyment of recreationists using the three sites between the minesite and Absarokee; however, use of the Stillwater River for canoeing, rafting, and kayaking probably would not decrease as a result of the project.

Deterioration of fishing access sites and campgrounds may occur in other ways. Recreationists would have more difficulty finding an uncrowded access site. Restrictions may have to be placed on the length of camping allowed at the sites to deter temporary mine workers from living there. The Montana Department of Fish, Wildlife, and Parks would have to rely heavily on the county sheriff's department to control additional use (Ray Burnsten, personal commun., March 2, 1982).

The use of commercial dude ranches and outfitters would not be reduced by the project because the area used by outfitters would not be affected. (See National Forest Recreation Resources.) More traffic would pass the dude ranches; one is owned by Anaconda.

4. Community Recreation Resources

Additional recreational facilities would be required in Absarokee in proportion to the expanded population.

5. Road Management

Projected ore hauling on the county road between Nye and the mine would demand about 50 trucks every 24 hours, or two loaded trucks each hour on the road segment for about ten minutes. This would not create a significant hazard to recreation travelers on the county road. Visitors would probably pass only one truck going the other way between the mine and Nye; occasionally, they would follow or be followed by a truck moving in the same direction. If the hauling schedule is compressed into a shorter period--to make up for delays, for example--a hazard may occur, especially if additional trucks were put on the road during the periods when recreation visitor traffic peaks.

The added traffic caused by mill and mine workers one hour prior to and one hour following shift changes would be a significant impact. The

two-lane road between the mine and Absarokee would have a peak load of 75 to 150 cars during that period. This added load on Friday and Sunday afternoons could make driving slow, traffic conditions crowded, and decrease the safety of national forest users.

6. Mitigating Measures

No mitigating action is considered necessary to protect national forest recreation or Wilderness; however, the Forest Service does have the option of increasing on-the-ground administration on national forest lands with the possibility of requiring permits for Wilderness use to control an increased number of people.

There are at least two ways of mitigating the traffic caused by mine and mill shift changes. First, shift changes could be disallowed from 2 p.m. to 7 p.m. on Fridays or Sundays, Memorial Day through Labor Day. On three-day weekends, they could be disallowed from 2 p.m. to 7 p.m. Thursday, instead of Friday (or Monday instead of Sunday). Second, employees could be bussed to the mine and mill from Absarokee, thereby eliminating the bulk of the traffic created by Anaconda employees. No restriction in shift changes would then be necessary. Anaconda would be encouraged to take one of these or other appropriate mitigating actions. If increased traffic from mine shift changes were demonstrated to be a safety hazard, the Forest Service would require Anaconda to alleviate the problem.

Q. CULTURAL RESOURCES

1. Summary of Impacts

Two cultural resource sites are located within the permit boundaries of the Anaconda Stillwater project and could be affected by vandalism or mine-related disturbances. Five additional sites, outside the permit boundaries, but within the study area, may be adversely affected by road regrading and reconstruction. Six other sites are outside the permit boundaries and might be affected by an increased probability of vandalism. All of the above sites are potentially eligible for listing on the National Register of Historic Places because of their potential to yield information on the history and prehistory of the area. Of the thirteen sites, the Forest Service is submitting the five that lie on national forest lands to the Keeper of the National Register for a determination of eligibility.

2. Description of the Impacts

Prior to permit approval, the Department of State Lands and the U.S. Forest Service are required to take measures to protect cultural resources (82.4.335 MCA [ARM 26.4.106 (101)] and the Historic

Preservation Act, Section 106). Protection can include avoidance, the recording of all information contained in a site, or other measures agreed on by the agencies and the company. The cataloging of this information will ultimately lead to an improved understanding of the past--both historic and prehistoric.

Of the 23 cultural resource sites within the study area, the buffalo jump would be most directly affected by mining-related activities, even though it is outside the project's permit boundaries. The outlying areas of this site would probably suffer from physical loss and disturbance of cultural materials due to road upgrading and reconstruction. A stone ring site (the Guthrie site) is bissected by the road and would receive similar impact. Three homesteads would be adjacent to the road reconstruction/upgrading but would probably not be affected because they are still occupied. Two other sites, one mining-related site and the small cave, are within the permit area and may be directly affected by blasting or mine expansion. Six other sites (stone features and structural remains of mining or homestead activities) are outside the permit area, but could be affected due both to the increased number of people in the area and to the fact that the area is open range (and thus, there are no fences on property lines). The probability of vandalism is therefore greater. All thirteen sites are potentially eligible for the National Register.

The Forest Service is seeking a determination of eligibility for some of the sites on national forest land. Once this is complete, the Forest Service can proceed to develop and implement mitigation plans as necessary. Additional potentially eligible sites both on and off the forest lands would only be protected to the extent that the company agrees to mitigation measures recommended by DSL.

The remaining 11 cultural sites are not eligible for the National Register, would not be affected by mining and related activities, and have been recorded and the information from them preserved.

3. Mitigating Measures

To mitigate the impacts of road upgrading, the State Historic Preservation Office recommends that the company completely record, by mapping, excavation, or test excavations (based on approved research designs), the Guthrie ring site and record the outlying areas of the buffalo jump which overlap the road right-of-way. In addition, the company could have an archaeologist on hand during construction to assure minimal impact.

To mitigate impacts on the cave site, which lies within the permit area, the company should either excavate and record the site or monitor it for effects from blasting or other sources of damage. If damage were noted or appeared likely to occur, a mitigation plan should then be put into effect.

To mitigate potential impacts on other sites, the company could post them with no trespassing signs located to prevent trespass but not draw attention to the site.

If Anaconda exposes previously unidentified sites on national forest land during excavation and construction, they would be required to (1) cease activities that could further damage the site and (2) notify the U.S. Forest Service. If the company exposes previously unidentified sites off national forest land, it should contact the Department of State Lands and the State Historic Preservation Office.

R. AESTHETICS

1. Summary of Impacts

The proposed activities would significantly affect visual resources at the mine and mill sites. The Visual Quality Objective (VQO), based on mapping done by CDM (1980), for each area would not be met, and highly noticeable views for recreation travelers and some local residents would result.

Noise levels near the mine, mill, and the highway connecting the two (parts of FAS 419 and FAS 420) would increase. The resulting noise levels may be highly annoying to nearby residents.

2. Description

a. Minesite

The waste rock dump would be the most obvious and least mitigatable visual impact. The waste rock would be light in color--white to gray--and would probably weather slowly. The rocks would vary from particles the size of sand to stones 12-15 inches in diameter. The size of the dump would increase continuously. After 20 years it would rise 40 feet above FAS 419 and be a highly objectionable sight for recreation travelers. The visual impact would exist until reclamation was completed.

The dump would be the dominant feature of the mining operation. Its color, texture, size and shape would preclude meeting the VQO of Retention. (See chapter III, Aesthetics.)

Several buildings would also be added to the landscape. The 70-foot-high crushing facility would stand above the road-user's line of sight; it would be obvious from FAS 419. The portal to the explosives storage and the associated disturbed area would also be obvious from FAS 419. This portal is in the same vicinity as an adit entrance rejected in a May 1979 Forest Service Environmental Analysis Report (on file with Custer National Forest). The portal entrance was rejected by the Forest Service because of the visual impact its development would have had.

Two roads would be constructed at the minesite: the ore haul road from FAS 419 to the loadout and a relocation of Forest Service (FS) road 846. This new construction would be located in the VQO Retention/High area with an EVC of 2 (unnoticed disturbance) and 3 (minor disturbance). The ore haul road would be highly visible in an undisturbed area. The relocation of FS 846 would have a lesser impact, since it is in the background of major surface disturbance caused by the mine. The VQO would probably be met after the cessation of mining. All structures would be removed and the area reclaimed. (See chapter I.)

b. Mill site

The construction of a 30-acre milling complex and 113-acre tailing impoundment would significantly change the visual resources of the area. These changes would not be subordinate to the characteristic landscape. That is, the structure and disturbance would be obvious to nearby residents and persons traveling FAS 420. Therefore, the VQO of partial retention would not be met.

On the other hand, the complex would not be visible from FAS 419, the primary access to Woodbine Campground and the Absaroka-Beartooth Wilderness. Nor would it be visible from those portions of the Wilderness receiving the majority of use: the valley bottom and plateau trails.

The partial retention VQO would probably be met after cessation of mining. All structures would be removed and the area reclaimed. (See chapter I.)

c. Noise

Noise levels near the mine, mill, and 7-mile segment of FAS 419 and FAS 420 between the facilities would increase. The primary noise sources would be haul trucks, heavy machinery, and possibly blasting. The resulting noise levels near the mine and mill are not known, nor are the impacts to nearby residents.

Residents near the haul route on FAS 419 and FAS 420 may be adversely affected by the truck traffic. As proposed, the trucks would make five one-way trips per hour: a haul truck would pass a given point on the road every 12 minutes. These trucks may produce a noise level up to 80 decibels (dBA) measured at 50 feet from the road (Theissen, 1974). This level may be great enough to interfere with normal outdoor activities; some interruption of indoor activity may also occur (Environmental Protection Agency [EPA], 1974). Since the trucks would operate at night, some residents living close to the road may be awakened (EPA, 1973). The increase in noise levels would not be a health hazard (EPA, 1974).

3. Mitigating Measures

a. Visual Resources

To reduce the color contrast between the buildings and surroundings, the Forest Service would require all structures on Federal land to be painted with flat earth-tone colors characteristic of the surrounding landscape. The Forest Service would encourage the same treatment for structures on private land.

The Forest Service would require the haul road from the loadout to FAS 419 to be located on the flat east of the loadout. This would minimize the length of the road and the size of the roadcut. Hence, disturbance visible from FAS 419 would be reduced. To further reduce visibility of the mining operation, the Forest Service would require Anaconda to plant a conifer shelterbelt in two places: (1) on the west side of FAS 419 from the Hjelvik's entrance to the south end of the waste dump and (2) on the north side of the relocated haul road.

To mitigate the visual impact of the fill slope adjacent to the explosive storage, the Forest Service would require Anaconda to reduce the size of the slope by increasing its grade to approximately the same as the slope adjacent to the explosive storage.

The Forest Service would suggest that Anaconda construct a visitor's turnout on FS 846 above the mine and, with signs or handout material, explain the mining operation.

b. Noise

Restricting truck traffic to the hours between 7 a.m. and 7 p.m. would eliminate any sleep interruptions. Anaconda should encourage the ore-hauling contractor to undertake noise reduction measures on the trucks. For example, "damping of various cover plates and of the engine block can reduce the noise of diesel engines by about 6 dBA, while better construction and sealing of the whole engine compartment and introducing some absorption usually can provide a similar amount [of reduction] by reducing the [sound] transmission to the outside" (Theissen, 1974).

If the Department of State Lands determined that nearby residents were adversely affected by increased noise levels, the Department could require Anaconda to implement measures necessary to reduce nuisance noise levels.

CHAPTER V

APPENDICES

APPENDIX 1

EVALUATION MATRIX OF MILL/TAILING POND SITING ALTERNATIVES

	Robinson Draw A	Hertzler Ranch I B	Hertzler Ranch II C	Hertzler Ranch III D	Stanley Coulee E	Prairie Creek F	Stratton Ranch G	Limestone Cove H	Old Tailing Area I	Mine Site J	Beartooth Ranch K
Geology/Soils											
Geologic Structure	3	5	5	5	3	3	1	1	1	1	3
Slope Structure	3	5	5	5	3	3	1	5	3	3	5
Construction Materials	3	5	3	3	3	3	3	3	1	1	1
Foundation Conditions	3	5	5	5	3	3	3	3	1	1	3
Permeability	1	5	1	1	3	1	1	1	1	1	1
Hydrology											
Flood Plain Encroachment	5	5	5	5	5	5	3	3	1	1	1
Drainage Basin Area	1	5	5	1	3	1	3	5	5	3	3
Ground Water Proximity	1	5	1	1	3	3	1	1	1	1	1
Design and Construction											
Seepage Control Potential	3	5	1	1	3	3	1	1	1	1	1
Storm Diversion Control	1	5	5	1	1	1	3	5	5	3	3
Pond Expansion Potential	3	5	5	5	1	3	5	3	1	1	1
Erosion Potential	3	3	3	3	5	5	3	1	1	1	1
Land Form Alteration	1	5	1	1	3	3	3	1	1	1	1
Additional Land Requirements	1	5	5	5	1	1	3	1	3	3	1
Capital Cost	1	5	3	1	1	1	1	1	1	1	1
Mill/Pond Operation											
Proximity of Mill/Pond to Mine	1	1	1	1	1	1	3	3	5	5	3
Process Water Recylcing	1	5	5	5	1	3	1	3	3	5	1
Operating Cost	1	3	3	3	1	1	3	3	5	5	3
Production Limitations	1	3	5	5	1	3	3	1	1	1	1
Abandonment											
Reclamation/Revegetation Potential	1	5	5	3	1	1	3	1	1	1	1
Post Operational Pond Maint.	3	5	5	3	3	1	3	1	1	1	1
Abandonment Costs	1	5	5	3	1	1	3	1	1	1	1
In-Perpetuity Costs	3	5	5	3	3	1	3	1	1	1	1

<u>Air Resources</u>											
Particulates if Tailing Dry	5	3	3	5	5	5	5	5	3	5	5
<u>Wildlife</u>											
Critical Habitats Threatened & Endangered Species	1	3	3	3	1	5	3	5	5	5	1
Human Disturbance	3	5	5	5	3	3	5	5	5	5	1
Diversity	3	5	5	5	3	5	5	5	5	5	3
<u>Vegetation</u>											
Reclamation/Diversity	1	5	5	5	1	1	5	5	5	5	5
Threatened & Endangered	1	5	5	5	1	1	3	3	5	5	5
<u>Aquatic Ecology</u>											
Major Fishery	5	3	3	5	5	5	3	1	1	1	1
<u>Soils</u>											
Production Potentail	3	3	1	1	3	1	3	3	5	5	5
<u>Recreation</u>											
Recreation Impacts	3	3	3	3	3	5	3	3	3	3	1
<u>Transportation</u>											
Road Traffic Impacts	1	1	1	1	1	1	5	5	5	5	1
<u>Aesthetics/Land Use</u>											
Land Use/Visual Quality	3	5	5	5	3	3	1	1	3	3	1
<u>Cultural Resources</u>											
National Register of Historical Places Eligibility	1	5	3	5	1	3	5	3	5	5	1
<u>Permitting</u>											
Overall Regulatory/Reclamation	1	5	3	3	1	1	5	3	3	3	3

(1) Major Impacts, (3) Moderate Impacts, (5) Minor Impacts

APPENDIX 1
(Continued)

EVALUATION SUMMARY OF MILL/TAILING POND SITING ALTERNATIVES

Alternatives		Major Impacts (1)	Moderate Impacts (3)	Minimum Impacts (5)	Cost	
					Capital	Operating
Robinson Draw	(A)	18	15	2	High	High
Hertzler Ranch I	(B)	2	6	27	Low	High
Hertzler Ranch II	(C)	5	9	21	Mod.	High
Hertzler Ranch III	(D)	10	13	12	Mod.	High
Stanley Coulee	(E)	16	16	3	High	High
Prairie Creek	(F)	15	15	5	High	High
Stratton Ranch	(G)	12	19	4	High	Low
Limestone Cove	(H)	17	13	5	High	Low
Old Tailing Area	(I)	18	5	12	High	Mod.
Mine Site	(J)	18	6	11	High	Low
Beartooth Ranch	(K)	25	7	3	High	Low

APPENDIX 2

FLOTATION REAGENTS USED IN MILLING PROCESS

A. SUMMARY OF POTENTIAL IMPACTS

After the milling reagents in the tailing slurry leave the mill, they would enter the tailing pond. Based on the following information, the mill reagents would not be expected to present a significant environmental hazard: (1) the expected concentrations of these reagents that would reach the tailing pond would be low, (2) the amount of tailing water seeping into the ground water of the Hertzler Valley would be very small in comparison to the total amount of ground water flowing through the valley, and (3) the composition and amount of reagents would change during infiltration through tailing and earth materials; the reagents may decompose in the tailing pond, as do many other organics, or they may be absorbed or altered in composition (from complexes or precipitates, for example) during percolations through the tailing impoundment and underlying material.

B. THE FLOTATION PROCESS

The chemicals Anaconda currently plans to use in the mill flotation process are copper sulfate, Aeroxanthate 350 (potassium amyl xanthate), Hercules TDL (carboxy methyl cellulose) and Dowfroth 200 (polyglycol ether). Once the exact milling process is decided on, Anaconda may make some minor changes in the chemicals used; however, all chemicals would be similar in chemical composition to the ones discussed here.

The flotation, or more specifically the froth flotation, process that Anaconda proposes to use is a physical-chemical method of separating and concentrating the metals in finely ground ores. In the process, the crushed ore is mixed with chemicals in a water solution to create conditions favorable for the attachment of desired minerals to air bubbles. The air bubbles carry the minerals--sulfide minerals in this case--to the surface of a slurry pulp. A froth containing the minerals forms at the surface of the slurry and is skimmed off while the other constituents in the ore rock remain submerged (Dow Chemical Company, 1976., p. 2). The froth is then dewatered and sent to a refining plant--Anaconda has not yet specified where--for processing to extract platinum-group and other precious metals. The pulp slurry left at the bottom of the flotation cells is piped to the tailing pond for disposal. The froth flotation process would recover over 90 percent of the precious metals in Anaconda's original ore.

The function of the reagents in the flotation process are as follows:

Aeroxanthate 350 (potassium amyl xanthate). This compound is an anionic flotation collector used for sulfide mineral ores. The collector is the most important chemical in the flotation process, since

it is the reagent that produces a film on sulfide mineral particles and causes the particles to attach firmly to the rising air bubbles.

Hercules TDL (carboxy methyl cellulose). This compound is used as a dispersant and to protect certain mineral surfaces against the action of other flotation agents. This compound helps settle out unwanted tailing, such as clays, which tend to reduce the effectiveness of the flotation process. It also reduces the consumption of the xanthate collector.

Dowfroth 200 (polyglycol ether). This compound is a frothing agent that is used to give a temporary toughness and elasticity to the air bubbles used to float the desirable minerals to the surface. It also lowers the surface tension of the water, much the same way a household detergent works. All of the frothers presently in use are organic heteropolar compounds (Dow Chemical Company, 1976, p. 9).

Copper Sulfate. This copper salt is added to the flotation process to allow the xanthate collector to effectively cause nickel, cobalt, iron, and zinc sulfide minerals to become attached to the air bubbles. Without it, these sulfides would not readily attach.

C. AMOUNT OF THE REAGENTS ENTERING TO THE TAILING POND

Eighty to 90 percent of the Dowfroth reagent used in the mill would be removed with the mineralized froth. The other 10 to 20 percent would enter the tailing pond (Montana Department of State Lands and Kootenai National Forest, 1978, p. 314). The xanthate collector is designed to coat the sulfide minerals; therefore, very little would leave with the tailing (Montana Department of State Lands and Kootenai National Forest, 1978, p. 314). As can be seen by the low amount of metals that would remain after the ore is processed (see chapter IV, Hydrology, Ground Water) not much of the copper sulfate would enter the tailing pond either. In contrast, most of the cellulose dispersant would probably end up in the tailing pond.

D. TOXIC POTENTIAL OF THE FLOTATION REAGENTS

Dowfroth. The environmental effects of Dowfroth are poorly known. Even so, it is not expected to cause ground water in the Hertzler Valley to become unusable for either drinking water or irrigation, because the concentration would be low in the tailing pond and would therefore be greatly diluted upon reaching the ground water of the valley. Dowfroth is not toxic to vertebrates if ingested orally even at much higher concentration than expected to be in the tailing pond water (Botz, Hydrometrics, 1978, in written commun. to Loren Bahls of the Montana Water Quality Bureau).

Aeroxanthate 350. Potassium amyl xanthate has a significant biological oxygen demand. In one study, 100 percent mortality in rainbow trout occurred at concentrations of 1.0 mg/l in 28 days (Botz, Hydrometrics, 1978)). In the Anaconda Stillwater Project, however, the dilution of this chemical in the ground water system of the Hertzler Valley should render it harmless before it ever reaches either a domestic or stock well, or any surface water.

Copper Sulfate. A large percentage of the copper and sulfate used in the flotation process would stay with the mineralized froth collected at the mill. The remaining amount would neither adversely affect vegetation growing on the reclaimed tailing dam nor cause significant increases in copper or sulfate levels of the Hertzler Valley ground water system.

Hercules TDL. Even though most of the cellulose dispersant would end up in the tailing pond, it is a synthetic organic compound and would not present a water quality hazard to natural water of the Hertzler Valley (Richard Pederson, oral commun., January 1982, Department of Health and Environmental Sciences).

CHAPTER VI

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CHAPTER VII

CONSULTATION AND COORDIANTION

A. DEVELOPMENT OF THIS STATEMENT

The following individuals, agencies, and companies (other than those cited in the text) provided information used to analyze Anaconda Minerals Company's proposed project.

Government Agencies

Montana State Board of Education, Helena (State Historic Preservation Program)

Montana Department of Administration, Research and Statistical Services (Helena)

Montana Department of Commerce, Economic and Community Development Division (Helena)

Montana Department of Commerce, Hard Rock Mining Assistance Board (Helena)

Montana Department of Fish, Wildlife, and Parks (Helena)

Montana Department of Justice, Highway Traffic Safety section (Helena)

Montana Department of Highways, Planning and Research Bureau (Helena)

Stillwater County Planning Office (Columbus)

Sweetgrass County Planning Office (Big Timber)

U.S. Army Corps of Engineers

U.S. Department of the Interior, Bureau of Mines, Minerals Availability Field Office (Denver, Colorado)

Nongovernment

Dwight Bergeron, Wildlife Biologist, Independent Contractor with the Department of State Lands (Helena)

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- B.S. Forestry, Colorado State University, 1958

George Schaller, Supervisory Forester
- B.S. Forestry, University of Missouri, 1957

Jim Shell, Forester
- B.S. Forestry, Colorado State University, 1970

Sue Zike Koch, Landscape Architect
- B.S. Landscape Architecture, Iowa State University, 1974

The Department of State Lands and the U.S. Forest Service appreciate the assistance of Anaconda Minerals Company, which provided information on the proposed mine.

B. REVIEW OF THIS STATEMENT

Copies of this draft EIS will be made available to the public for comments and suggestions. All comments received will be carefully considered in the preparation of the final EIS. Written comments should be sent to either Commissioner Gareth Moon, Department of State Lands, 1625 11th Avenue, Helena, MT 59620, or James Mann, Supervisor, Custer National Forest, P.O. Box 2556, Billings, MT 59103.

The draft EIS is available for review in the following places:

Montana Department of State Lands, 1625 11th Avenue, Helena, Montana.

Custer National Forest, Supervisors Office, 2602 1st Avenue North, Billings, Montana.

Custer National Forest, Beartooth Ranger District, Red Lodge Ranger Station, Red Lodge, Montana.

Parmley Billings Public Library, 510 North Broadway, Billings, Montana.

Stillwater County Library, 400 3rd Avenue North, Columbus, Montana.

A limited number of copies are available on request from the Department of State Lands, 1539 11th Avenue, Helena, Montana 59620 and the U.S. Forest Service, P.O. Box 2556, Billings, Montana 59103.

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